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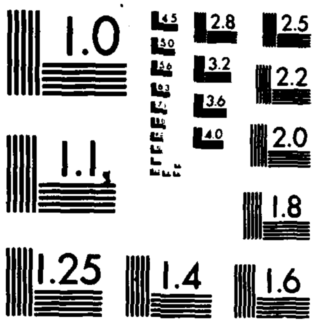

MICROCOPY RESOLUTION TEST CHART
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This pilot study computer simulation captures the contributions of inexperienced and experienced personnel to overall organizational effectiveness at the Aeronautical Systems Division.

The model is appropriately responsive to changes in experience level, SPO leadership, priority, funding, and other factors. Given a fixed number of total personnel authorizations and a fixed percentage of inexperienced personnel, the model indicates that assigning the inexperienced to lower priority

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SPOs results in a maximum organizational measure of effectiveness (MOE). It also shows that an assignment policy based upon both priority and funding level may have only small impact upon this high MOE. Similarly, assigning all of the inexperienced to the high priority SPOs results in a relatively low MOE. Improving the SPO leadership increases the value of the MOE, but cannot compensate for high percentages of inexperience. The model can also assign SPO directors.

A PILOT STUDY OF A DYNAMIC MODEL FOR DETERMINING THE OPTIMUM DISTRIBUTION OF EXPERIENCED AND INEXPERIENCED PERSONNEL AT THE AERONAUTICAL SYSTEMS DIVISION

(F33615-82-M-5515)

For

Air Force Business Research Management Center

AFBRMC/RDCB

Wright-Patterson AFB, Ohio 45433

By

PJSA, Inc.

January 1983

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EXECUTIVE SUMMARY

This pilot study computer simulation captures the contributions of inexperienced and experienced personnel to overall organizational effectiveness at the Aeronautical Systems Division.

The model is appropriately responsive to changes in experience level, SPO leadership, priority, funding, and other factors. Given a fixed number of total personnel authorizations and a fixed percentage of inexperienced personnel, the model indicates that assigning the inexperienced to the lower priority SPOs results in a maximum organizational measure of effectiveness (MOE). It also shows that an assignment policy based upon both priority and funding level may have only small impact upon this high MOE. Similarly, assigning all of the inexperienced to the high priority SPOs results in a relatively low MOE. Improving the SPO leadership increases the value of the MOE, but cannot compensate for high percentages of inexperience. The model can also assign SPO directors.

Since this is an unvalidated pilot study, the author suggests that formal surveys be conducted along the lines of those used in this study, that the model be modified and

verified utilizing these new survey data, and that four SPOs be selected for a test. If the test results verify the results of this initial pilot study, it is recommended that the Aeronautical Systems Division consider this work when evaluating current and future personnel assignment policies.

I. INTRODUCTION

Personnel assignment policies can significantly affect the performance of any organization. This pilot study dynamic computer simulation captures the cause and effect relationships of experienced and inexperienced personnel assignment policies with overall organizational effectiveness.

During the summer of 1981 and with the sponsorship of the Air Force Office of Scientific Research, the author developed "A System Dynamics Model of the Acquisition Process." This earlier effort was the basis for the current study in the area of weapon system development personnel assignment policy.

In weapon system acquisition effectiveness is measured as a function of cost, schedule, and performance. During this study a small sample survey was conducted to determine the relative values of meeting cost, schedule, and performance criteria. These data were then used to compute overall organizational effectiveness of various personnel assignment policies.

The model is quite flexible and includes two phases (conceptual and development for instance) and two different weapon systems (a high and a low priority program). The

results can be shown in both graphic and tabular form. Other innovations are included that significantly add to the utility of the model.

II. BRIEF SUMMARY OF METHODOLOGY AND MODEL

After developing a general flow diagram of the weapons system development process and with the assistance of Captain Michael Tankersley of the Air Force Business Research Management Center and Mr. James Cooley of the Aeronautical Systems Division (ASD), the authors explained this diagram to eight eminently qualified ASD program managers. This group consisted of one Lt. Colonel, two GS-14s, two GS-13s, and three Captains. They understood the objectives of the study, their participation requirements, and the causal effect relationships associated with the weapons system development process.

These program managers (PM) also completed a survey instrument that was used to quantify their perceptions of SPO operations. The PMs plus nearly two dozen other qualified SPO program managers were next provided a second survey that measured their perceptions of the relative importance of cost, schedule, and performance.

The model is based upon the feedback relationships of personnel contributions upon cost, performance, and schedule during the weapon system development process. This initial model contains two system program offices which can be tracked during two consecutive development phases. It shows cost, performance, and schedule progress plus the measures of effectiveness as a function of time in both graphical and tabular form.

III. SURVEY AND SIMULATION RESULTS AND FINDINGS

A. Survey Results

The initial survey was completed and returned by six participants. The results are shown in Tables 1 through 9. Table 1 shows not only that the more capable SPO Director make a greater impact on progress than a less capable person, but also the respondents' perception of the magnitude of this effect.

TABLE 1

SPO DIRECTOR EFFECTIVENESS VERSUS PROGRESS

	Poor SPO Director	Good SPO Director
Progress	0.3	1.2
	0.0	1.9
	0.95	1.05
	0.9	1.6
	0.1	1.2
	0.0	1.0
Average	0.375	1.325

Note: Multiply these data by 100 percent to compute effect on planned progress. A 1.2 means progress can be increased from planned by 20 percent.

Table 2 indicates that increasing funds by 50 percent will increase progress by only 24 percent. Decreasing funds by 50 percent results in nearly a 50 percent decrease in progress.

TABLE 2

FUNDS VERSUS PROGRESS

	50% Planned Funds	150% Planned Funds
	0.8	1.30
	0.25	1.25
	1.00	1.00
	0.80	1.20
	0.10	1.50
	0.0	1.20
Average	0.49	1.24

Note: Multiply these data by 100 percent to compute the effect of funding changes upon progress. A 50 percent increase in funds will increase progress from planned by 24 percent.

Table 3 indicates the respondents perceived that the top SPO Directors can effect significant (43 percent) changes in progress when they desire to do so. The worst SPO Directors actually can slow progress when they desire and take action to improve progress.

TABLE 3

SPO DIRECTOR'S INFLUENCE ON CHANGING PROGRESS
WHEN HE DESIRES TO DO SO

	The Worst SPO Director	The Best SPO Director
	0.6	1.5
	0.5	1.9
	0.95	1.1
	0.5	1.2
	0.6	1.4
	0.0	1.5
Average	0.525	1.43

Note: Multiply these data by 100 percent to compute the effect on progress.

Table 4 indicates the respondents' perception of the time delay req'ired between progress and the reporting of that progress within a SPO. The data indicate a four plus month delay that is little affected by the size of the SPO.

TABLE 4

DELAY BETWEEN ACTUAL AND PERCEIVED PROGRESS

	Low Priority SPO	High Priority SPO
	30 months delay*	48 months delay*
	2	4
	2	0
	6	3
	6	18
	4	4
Average	4.4 months delay	4.8 months delay

*Discounted due to obvious difference from other data points.

Table 5 shows that respondents perceived that high priority SPOs could receive additional funds much sooner than low priority SPOs.

TABLE 5

TIME TO RECEIVE ADDITIONAL FUNDS AS A FUNCTION OF SPO PRIORITY

	Low Priority SPO	High Priority SPO
	12 months	2 months
	24	12
	18	3
	8	2
	13	3
	Indefinite*	0*
Average	15 months	4.4 months

*Discounted due to obvious difference from other data.

Tables 6 through 9 indicate the individual contributions of SPO personnel as a function of education, grade level, experience, and SPO assignments. Table 6 shows that the respondents perceived that education can significantly affect individual performance with the M.S. holder believed to be the top performer.

TABLE 6

INDIVIDUAL PERFORMANCE AS A FUNCTION
OF EDUCATION

	High School	Assoc Degree	B.S.	M.S.	Ph.D.
	0.0	0.2	0.4	0.6	0.8
	0.3	0.45	0.6	1.0	0.8
	0.5	0.6	0.8	1.0	0.8
	0.7	0.8	0.9	1.0	1.0
	0.7	0.85	0.9	1.0	0.8
	0.8	0.85	1.0	1.0	0.7
Average	0.5	0.625	0.77	0.93	0.82

Notes: 1. Numbers in columns indicate individual performance.

2. Multiply the value in the table by 100 percent to determine the percent of maximum performance.

Table 7 shows that individual performance is greatly affected by grade level. The GS-12 and 13 are perceived to be the highest performers in the SPO environment.

TABLE 7

INDIVIDUAL PERFORMANCE AS A FUNCTION OF GRADE LEVEL

	Grade (Rank) Level				
	GS-9	GS-11	GS-12	GS-13	GS-14
	0.8	0.3	0.4	0.3	0.1
	0.7	0.6	0.8	0.7	0.8
	0.7	0.8	0.9	1.0	0.9
	1.0	0.8	0.9	1.0	1.0
	0.2	0.9	1.0	1.0	1.0
	0.1	1.0	1.0	.95	0.9
Average	0.58	0.73	0.83	0.825	0.78

Notes: 1. Numbers in columns indicate individual performance.
2. Multiply the value in the table by 100 percent to determine the percent of maximum performance.

Table 8 indicates the respondents perceived that performance continues to increase as more and more R&D experience is gained.

TABLE 8

INDIVIDUAL PERFORMANCE AS A FUNCTION OF YEARS OF R&D EXPERIENCE

	Years of R&D Experience					
	0	4	8	12	16	20
	0.1	0.2	0.5	0.6	0.6	0.7
	0.2	0.4	0.7	0.7	0.8	0.9
	0.3	0.5	0.7	0.8	0.9	1.0
	0.4	0.6	0.8	0.9	1.0	1.0
	0.6	0.7	0.8	1.0	1.0	1.0
	0.7	0.9	1.0	1.0	1.0	1.0
Average	0.38	0.55	0.75	0.83	0.88	0.93

Notes: 1. Numbers in columns indicate individual performance.
2. Multiply table results by 100 percent to compute performance percentage of maximum, 100 percent.

Table 9 indicates little variability. Therefore, the respondents believed that the number of different SPO assignments had little effect on individual performance.

TABLE 9

INDIVIDUAL PERFORMANCE AS A FUNCTION OF NUMBER OF DIFFERENT SPO ASSIGNMENTS

	Number of Different SPO Assignments					
	0-1	2-3	4-5	6-7	8-9	10-11
	0.	0.	.5	.6	.3	.3
	.7	.75	.75	.7	.9	.3
	.7	.85	.85	.7	.9	1.0
	1.0	.85	.95	1.0	1.0	1.0
	1.0	1.0	1.0	1.0	-	1.0
Average	.68	.69	.81	.80	.74	.72

Notes: 1. Numbers in columns indicate individual performance.
2. Multiply table results by 100 percent to compute performance percentage of maximum, 100 percent.

The data obtained from Tables 6 to 8 were altered so that the top performers, the MS degree, the GS-12, and the 20 years of experience, could meet the planned cost, schedule, and performance of the model. This was accomplished by adding the difference between 1.00 and the highest average value in each table. For example, in Table 6, 0.07 was added to each average value for use in the model. Therefore, 0.57, 0.695, 0.84, 1.00 and 0.89 were used in the model rather than the unaltered values shown in Table 6.

The second survey instrument was designed to solicit paired comparison responses in order to quantify an overall "ASD" measure of effectiveness (MOE) as a function of individual SPO cost, schedule, and performance activity. The survey is in Appendix D and Figure 1 shows the paired comparison normalized results for the eighteen acceptable surveys received.

The numerical data of Figure 1 are shown in Table 10.

TABLE 10

COST-SCHEDULE-PERFORMANCE NORMALIZED VALUES

Cost-	40% Under-.110	Schedule-	20% Early-.071
	20% Under-.096		10% Early-.065
	On Target-.078		On Target-.063
	20% Over- .013		10% Late -.052
	40% Over -.001		20% Late -.051

Performance-	20% Above-.086
	10% Above-.084
	On Target-.084
	10% Below-.076
	20% Below-.069

Note: Example, .110 is 110 times as powerful as .001 when measuring ASD effectiveness.

This survey indicated that the most powerful factor in structuring a measure of effectiveness for ASD is cost and that being on or under cost is very significant. Being over cost is the most damaging to overall program or SPO success. Performance generally is more important than schedule. This indicates that when trades in performance

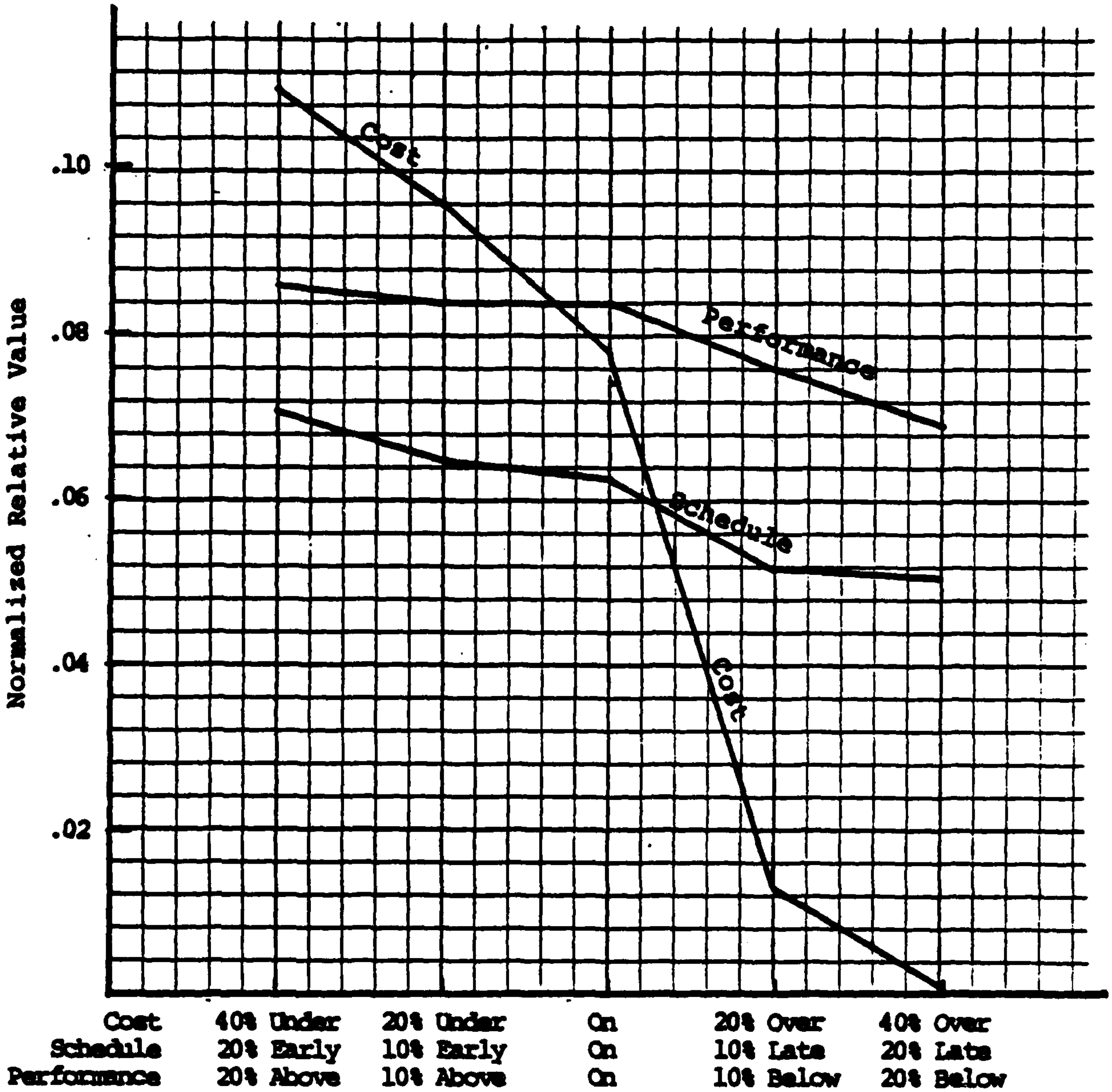

Fig. 1. Normalized Relative Values of Cost, Schedule, and Performance

or schedule are required, SPO personnel will prefer performance over the schedule--the system may be delivered late but it will meet the performance specifications.

Also included with this survey were questions concerning funding level and priority. The respondents were asked to indicate which would be a better organizational performance measure. Twenty of the twenty-one surveys received had this section completed appropriately. Three respondents selected funding level and seventeen selected priority as being the more important factor for use in the MOE equations. Of the seventeen, fourteen selected Air Force priority, two selected the ASD priority, and one selected the System Command priority.

B. Model Results

The model results are both in graphical and tabular form. However, for brevity only one graphical presentation will be shown in this section. Additional graphical presentations are in Appendix B.

Typical Output. This output shows the computer results of the basic run (Figure 2).

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	GSNC	XGSNC	LENGTH	PRTPER	PLTPER
PRESENT	.5000	.5000	200.0	10.00	5.000
ORIGINAL	.1000	.3000	200.0	50.00	0.

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TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.00	.00	.00	.00	.0
10.	65.98	.00	12.43	.00	78.4
20.	183.97	.00	33.62	.00	217.6
30.	286.41	.00	53.92	.00	340.3
39.99	461.48	.00	89.91	.00	551.4
49.99	487.33	12.92	97.19	2.22	599.7
59.99	496.43	122.82	99.64	21.68	740.6
69.99	503.90	231.76	101.48	42.17	879.3
79.98	509.21	351.48	102.65	66.18	1029.5
89.98	512.93	483.50	102.97	95.92	1195.3
99.98	515.60	492.03	103.21	98.56	1209.4
109.98	517.53	500.58	103.59	100.75	1222.4
119.97	518.87	506.99	103.86	102.14	1231.9
129.97	519.59	511.49	104.08	102.44	1237.6
139.97	519.75	514.65	104.25	102.98	1241.6
149.97	519.96	516.86	104.39	103.46	1244.7
159.96	520.40	518.25	104.50	103.79	1247.0
169.96	520.97	518.78	104.60	104.04	1248.4
179.96	521.48	519.04	104.67	104.23	1249.4
189.96	521.93	519.47	104.71	104.38	1250.5
199.95	522.33	520.14	104.71	104.50	1251.7

Fig. 2. Typical Output, Tabular and Graphical

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Fig. 2.--Continued

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Fig. 2.--<u>Continued</u>

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PAGE 54    FILE BS6        01/03/83

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Fig. 2.--Continued

C. Findings

Several factors can affect an overall organizational measure of effectiveness (MOE). The model indicates that SPO Director effectiveness, priorities, and funding (dollar values) can significantly affect the resultant MOE value. Since most survey respondents considered priority rather than funding level as critical in determining a MOE, the basic model assumed an equal funding level for both high and low priority programs.

Table 11 shows the data for various alternative assignment policies used in a small demonstration of how the model would be used in ASD.

TABLE 11

ORGANIZATION DATA FOR DEMONSTRATION

Assumptions: 6 SPOs in the organization
1500 Total personnel
800 Inexperienced personnel
1200 Experienced personnel

SPO Identifier	SPO Priority	Relative Funding	Combination	Auth. Personnel
A	1	5	5	500
B	2	2	1	200
C	3	1	.333	100
D	4	2	.5	200
E	5	4	.8	400
F	6	1	.167	100
				Tot 1500

SPO Priority = AF priority
Relative Funding = (SPO Funding)/(Funding of Minimum Funded SPO)
Combination = (1/Priority)(Relative Funding)
Authorized Personnel = (Relative Funding)(100)

Note: Only the first phase is used from model results in the demonstration. Both phases could easily be used if desired.

TABLE 11--Continued

Possible Policies:	
I.	Equal distribution of experience
II.	All inexperience to low priority SPOs
III.	Inexperience to low combination of priority and funding
IV.	All inexperience to high priority SPOs

All model constants for the possible policies are shown in Table 12.

TABLE 12

MODEL CONSTANTS FOR DEMONSTRATION

	Policy			
SPO	I	II	III	IV
A	1,5,.2*	1,5,0	1,5,0	1,5,.6
B	2,2,.2	2,2,0	2,2,0	2,2,0
C	3,1,.2	3,1,0	3,1,1	3,1,0
D	4,2,.2	4,2,0	4,2,5	4,2,0
E	5,4,.2	5,4,.5	5,4,0	5,4,0
F	6,1,.2	6,1,1	6,1,1	6,1,0

*The first number is priority; the second number is funding; and the third number is ratio of inexperienced to total in SPO.

Measures of effectiveness for each SPO with each policy and an organizational MOE is shown as the total in Table 13.

TABLE 13

MEASURES OF EFFECTIVENESS FOR DEMONSTRATION

	Policy			
SPO	I	II	III	IV
A	30.96	33.77	33.77	24.55
B	6.19	6.75	6.75	6.75
C	2.06	2.06	1.31	2.25
D	3.10	3.10	2.62	3.37
E	5.39	4.19	5.39	5.39
F	1.12	0.65	0.65	1.12
Total	48.82	50.52	50.49	43.43

Note: All the numbers in the table are organization MOEs.

These demonstration results show the impact of four different personnel policies for a six-SPO organization. In this case, Policies II and III are superior to either I or IV. Assignments of inexperience personnel should be either to the low combination of priority and funding or exclusively to the low priority SPOs. Various priority and relative funding would impact on the MOE and the solution would be appropriately different from those shown in Table 13.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

This pilot study shows that computer simulation can contribute to improving personnel assignment policies for the Aeronautical Systems Division. The affects of varying the assignment policies to both experienced and inexperienced SPO personnel, the effects of SPO priority, funding, and leadership are demonstrated by the model.

This study utilized two rather small surveys and has not been validated by actual test or implementation.

B. Recommendations

This pilot study is the beginning of a series of efforts that must be completed prior to implementing the results. Below are listed the recommended steps necessary to validate the model results.

1. Conduct and evaluate a formal and large-scale survey of SPO personnel perceptions of the weapon system acquisition process. The initial survey of this study could be modified and used to meet this need.

2. Conduct and evaluate a formal and large-scale survey of SPO personnel perceptions of the relative values

of cost, schedule, performance, priority, and funding in weapon system acquisitions as it applies to ASD. The second survey of this study will require significant modification and improvement for clarity, but is a beginning for this effort.

3. Conduct and evaluate a formal and large-scale survey of SPO personnel perceptions of other factors such as leadership, delays, etc. that are significant to model results.

4. The above three surveys could be included in a single survey which should be formally approved and distributed through normal ASD channels.

5. With these new survey data the model should be modified and exercised. A significant number of policies should be tested in order to seek out the best possible and workable personnel assignment policy for ASD.

6. If the results of 5 above are encouraging, four SPOs should be selected for use in implementing the policy selected in 5. Two high and two low priority SPOs should be selected for this validation test. If possible select a large and small SPO for each priority class (high and low). Assign personnel according to the policy selected in 5 above. Monitor cost, schedule, and performance to note how well the model has predicted the observed activity.

7. If the results of 6 are highly correlated (actual versus model result), then consider implementing this validated policy ASD-wide.

C. Additional Thoughts

This pilot study was concerned with overall organizational performance and is based upon percentages of inexperienced personnel. It is the author's belief that policies also affect retention of personnel. It is possible that the optimum policy in the short term may in fact reduce the experience levels in the long term and thus negatively affect the long-term organizational effectiveness. Therefore, data concerning retention rates in various SPOs should be evaluated along with the results of the above efforts.

The model also indicates the results of changes in the overall experience level on effectiveness within ASD. As inexperienced personnel replace experience in greater and greater numbers it becomes more and more difficult to bring in weapon systems on time, within cost, and that meet specifications.

APPENDIX A

THE MODEL

MODEL GLOSSARY

AP=ACTUAL PROGRESS
APD=ACTUAL PROGRESS DELAY
APR=ACTUAL PROGRESS RATE
APRR=ACTUAL PROGRESS RATE SUMMATION FACTOR.
CE=COST ESTIMATING FACTOR
CLLP=CLIP FUNCTION
CR=COSTS REPORTED
CRPA=PLANNED COSTS VS. COSTS REPORTED RATIO
CRR=COSTS REPORTED RATE
CRTR=COSTS REPORTED DELETION FACTOR RATE
DCP=SWITCHING FUNCTION FOR COUNTER
DOLH=DOLLAR VALUE(BUDGET) OF HI. PRI. PROG.
DOLL=DOLLAR VALUE(BUDGET) OF LOW. PRI. PROG.
DTC=SPO DIRECTOR'S DESIRE TO CHANGE THE SITUATION
DTCT=SPO DIRECTOR'S DESIRE TO CHANGE PROGRESS
E=EXPERIENCE FACTOR TOTAL
EDCE=EDUCATION LEVEL OF EXPERIENCED PERSONNEL
EDF=EDUCATION VS. PERFORMANCE TABLE
ED1C=EDUCATIONAL LEVEL IN YEARS OF INEXPERIENCED PERSONNEL
FDEL=FUNDS DELAY
FUN=FUNDS DESIRED DUE TO SPENDING PATTERN
FUNDS=DELAYED FUNDS FUNCTION
GSE=FRACTION OF EXPERIENCED PERSONNEL IN THE SPO
GSN=FRACTION OF INEXPERIENCED PERSONNEL IN THE SPO
ME=MANAGEMENT EFFECT OF PERSONS ASSIGNED
PAP=PERCEIVED ACTUAL PROGRESS DELAYED
PAT=PERCEIVED ACTUAL TIME VS. PERCEIVED ACTUAL PROGRESS
PC=PLANNED COSTS
PCR=PLANNED COSTS RATE
PCTR=PLANNED COSTS DELETION FACTOR RATE
PGM=PROGRAM PLAN
PP=PLANNED PROGRESS
PPGM=PLANNED PROGRAM
PPVS=PLANNED PROGRAM VALUE FROM THE SCHEDULE
PRAP=PERCEIVED VS. PLANNED PROGRESS RATIO
PRIA=PRIORITY OF THE HIGH PRIORITY PROGRAM
PRIX=PRIORITY OF THE LOWER PRIORITY PROGRAM
PV=PROGRAM VALUE (PERFORMANCE)
PVA=PROGRAM VALUE FACTOR (PROGRESS/COST RATIOS)
PVR=PROGRAM VALUE RATE
PVTR=PROGRAM VALUE DELETION FACTOR RATE
RGCE=RANK OR GRADE OF EXPERIENCED PERSONNEL
RGF=RANK OR GRADE VS. PERFORMANCE
RG1C=RANK OR GRADE OF THE INEXPERIENCED PERSONNEL
RTTMS=TIME REMAINING TO MILESTONE
SPD=SPO DIRECTOR INFLUENCE

SPD1=DELAYED SPO DIRECTOR'S TOTAL INFLUENCE ON CHANGE.
SPDE=SPO DIRECTOR'S EFFECT ON CHANGE
SPDI=SPO DIRECTOR'S INFLUENCE DUE TO EFFECTIVENESS
SPDTI=TABHL FUNCTION OF SPDI
SPTI=SPO DIRECTOR'S TOTAL EFFECT ON CHANGE
TCF=TECHNICAL COMPLEXITY FACTOR
TDTC=TABHL FUNCTION OF DTC
TDTCT=TABLE FUNCTION OF DTCT
TE=TECH/MANAGEMENT FACTOR
TFUN=TABHL FUNCTION OF FUNDS
TIN=TIME IN PERIODS OF ONE (RATE)
TSMSO=TIME SINCE MILESTONE ZERO (COUNTER)
TSPDI=TABLE FUNCTION OF SPDI
TTMS1=TIME SINCE MILESTONE ONE
TX=SWITCHING FUNCTION
VAL11=THE VALUE OF THE HIGH PRIORITY PROGRAM IN PHASE ONE.
VAL12=THE VALUE OF THE HIGH PRIORITY PROGRAM IN PHASE TWO
VALT1=THE TOTAL VALUE OF BOTH PROGRAMS IN PHASE ONE
VALT2=THE TOTAL VALUE OF BOTH PROGRAMS IN PHASE TWO
VALTT=THE TOTAL VALUE FOR BOTH PROGRAMS IN BOTH PHASES
VALX1=THE VALUE OF THE LOW PRIORITY PROGRAM IN PHASE ONE
VALX2=THE VALUE OF THE LOW PRIORITY PROGRAM IN PHASE TWO
VCOST=THE CONTRIBUTION OF COST TO THE MOE
VPERF=THE CONTRIBUTION OF PERFORMANCE TO THE MOE
YRDCE=YEARS OF R AND D OF EXPERIENCED PERSONNEL
YRDF=YEARS OF R AND D VS. PERFORMANCE TABLE
YRD1C=YEARS OF R AND D OF INEXPERIENCED PERSONNEL
VSCH=THE CONTRIBUTION OF SCHEDULE TO THE MOE

THE MODEL

A. <u>The weapon system development model</u> (see Figure 3) is a dynamic computer simulation written for the DYNAMO compiler. The entire model consists of the modeling of two different weapon systems (high and low priority) each with two phases (phase 1 and phase 2). Each prioritized phase consists of six level equations. This is a feedback dynamic system in which changes to the system can be measured by the level equations. These equations are actual progress, planned progress, costs reported, planned costs, program value, and time since last milestone. With the exception of the time since last milestone, these level equations are the cost, schedule, and performance measurements associated with system program office effectiveness.

B. <u>Actual Progress Level</u>. The actual progress (AP) level is controlled by the actual progress rate (APRR), which is controlled by the technical/managerial factor (TE), the program plan (PGM), the SPO Director influence (SPD) and funding changes (funds) (see Figure 3a). Figure 3a depicts all factors that influence the above factors. In addition, the perceived actual progress (PAP) is dependent upon the actual progress and the actual progress delay (APD). Note in Figures 3a to 3f the relationships between factors in one figure to those in other figures are shown by arrows,

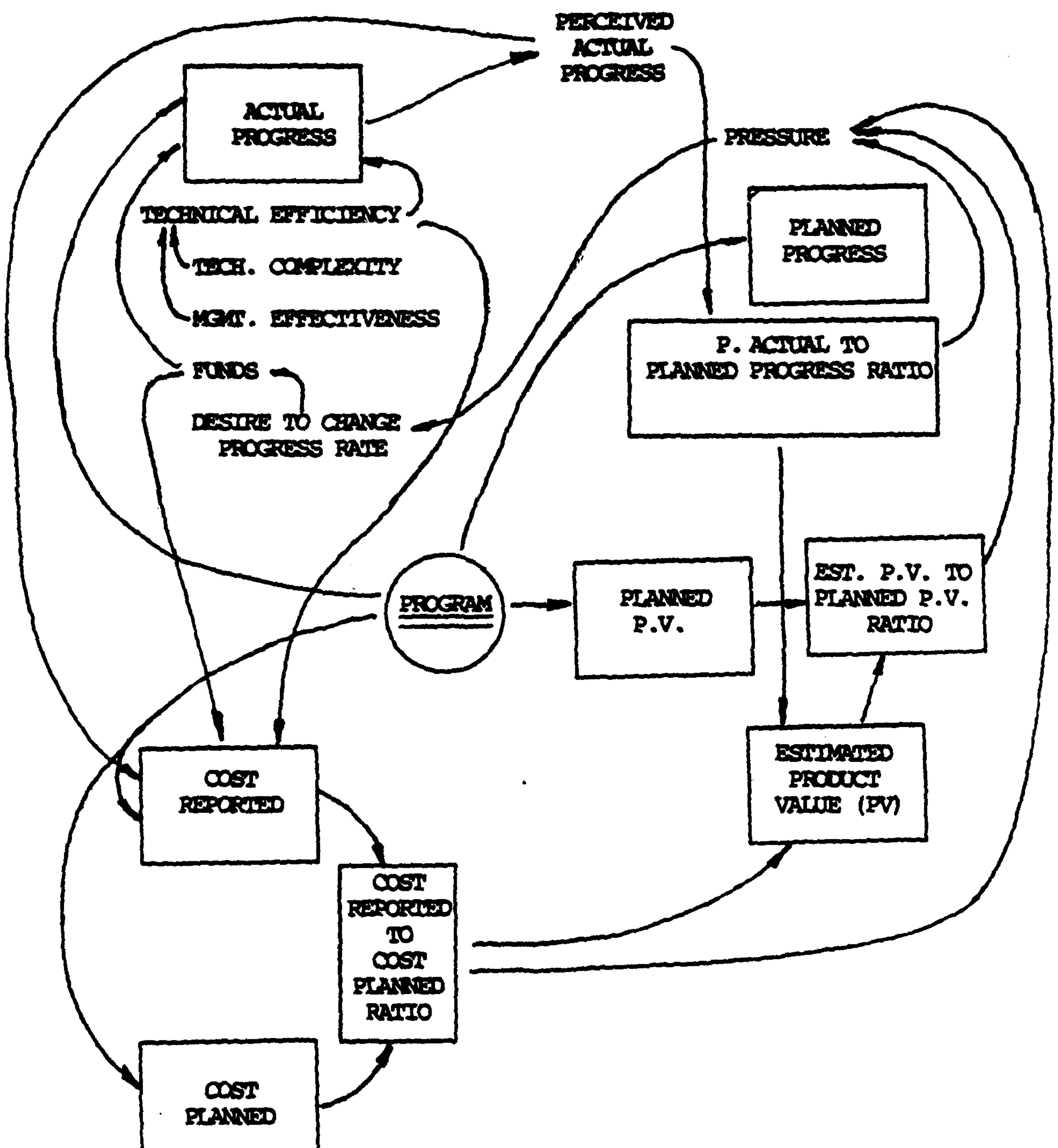

Fig. 3. Weapon System Development Flow Diagram

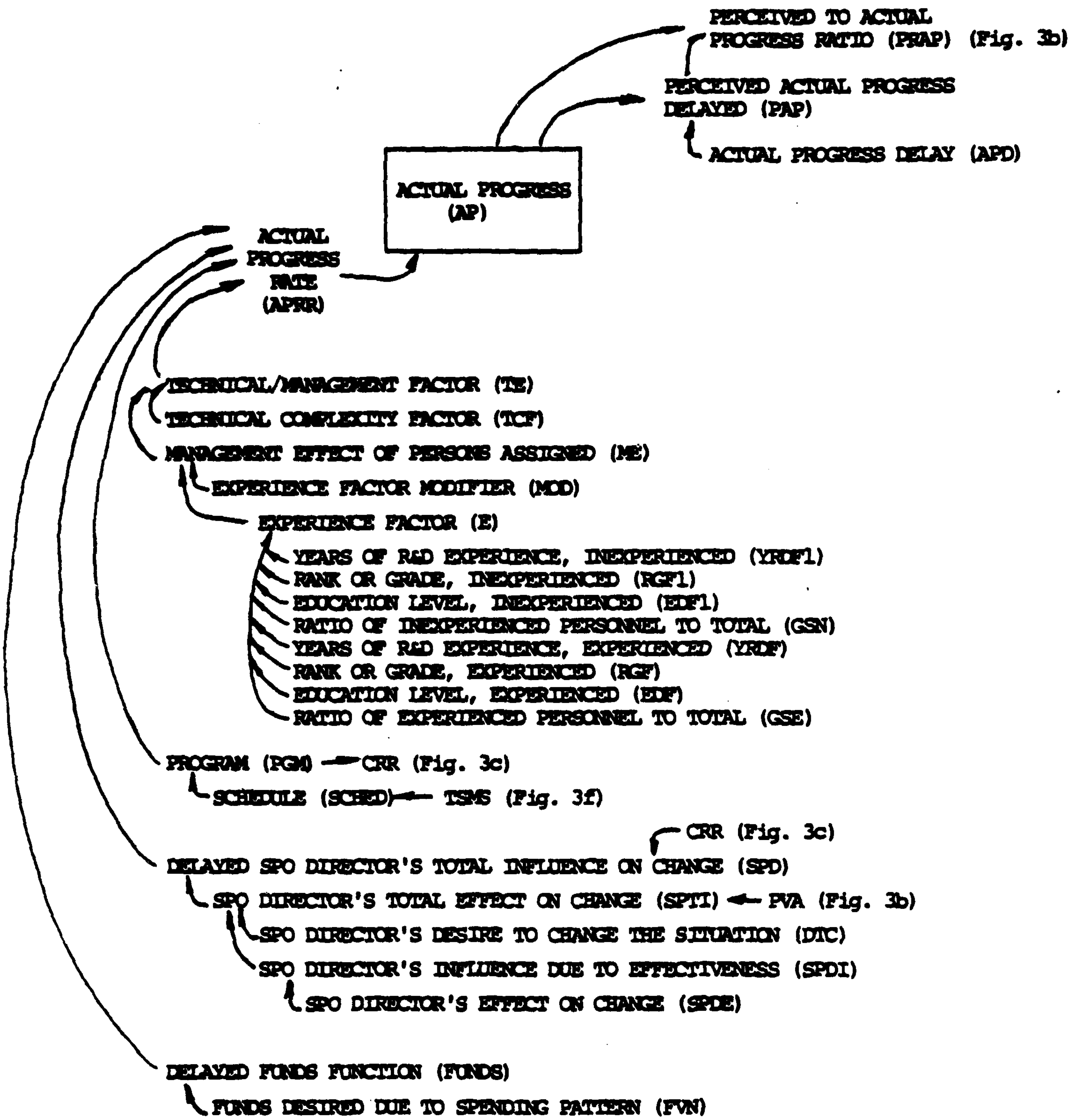

Fig. 3a. Actual Progress

the alpha identifier, and the figure number. For example, in Figure 3a program affects CRR (cost reported rate) in Figure 3c. Similarly, TSMS (time since milestone) of Figure 3f affects sched (schedule). This methodology is used to tie figures 3a to 3f into the simplified model shown in Figure 3.

C. Planned Progress. Planned progress is the planned and scheduled progress (PP) towards completion of the SPO program. The rate of change of the planned progress (PPGM) controls the level of progress. This rate is controlled by the planned schedule (PSCHD) which is controlled by the counter, time since milestone (TSMS) (see Figure 3b).

The planned progress in conjunction with the perceived actual progress ratio (PAP) control the perceived to actual progress ratio (PRAP). PRAP in turn along with CRPA from Figure 3c is used in computing the program value factor (PVA).

D. Costs Reported. Costs reported (CR) are equal to the actual expenditure of funds and is controlled by the cost reported rate (CRR). The CRR is controlled by the delayed SPO Director's total influence (SPD) and the program (both from Figure 3a), and the cost estimating factor (CE) (see Figure 3c).

The planned costs vs. costs reported (CRPA) is determined by the costs reported and the planned costs (PC) from Figure 3d. The CRPA contributes to PVA in Figure 3b.

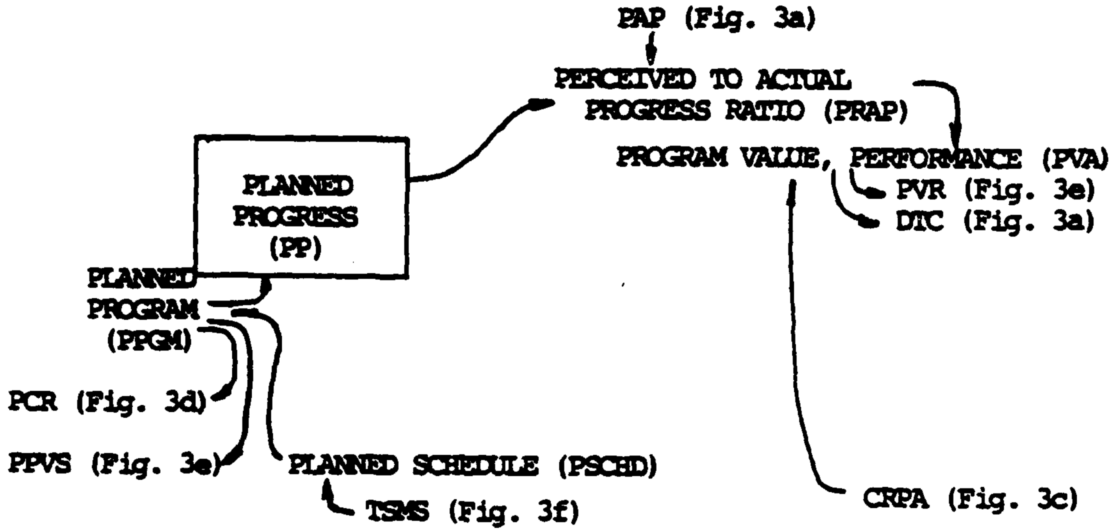

Fig. 3b. Planned Progress

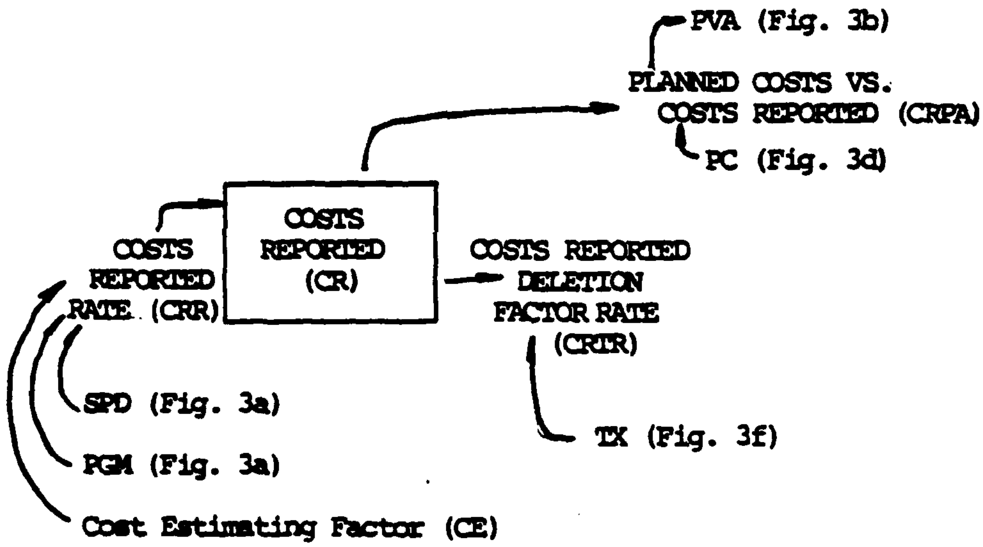

Fig. 3c. Costs Reported

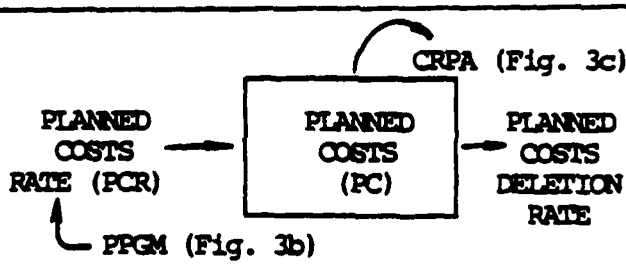

Fig. 3d. Planned Costs

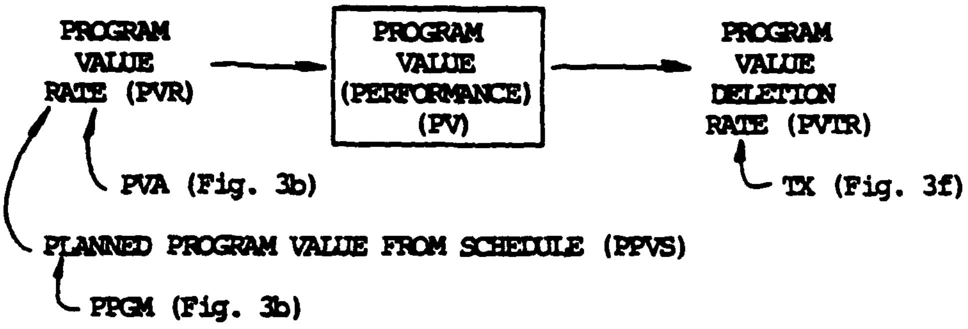

Fig. 3e. Program Value

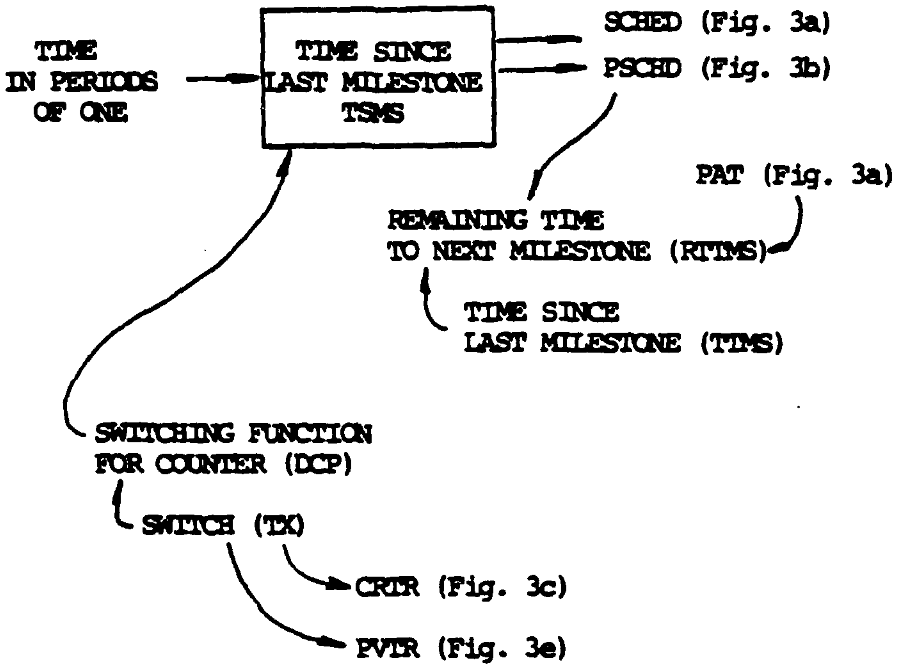

Fig. 3f. Counter Function

E. Planned Costs. Planned costs (PC) are predetermined and expend funds linearly during each phase (see Figure 3d).

F. Program Value. Program value (PV) is the performance indicator and reflects the progress as a function of costs expended ratio. The planned program value from the schedule (PPVS) is based upon a linear expenditure of funds and progress. PV is controlled by the program value factor from Figure 3b and PPVS (see Figure 3e).

G. Time Since Last Milestone. Time since last milestone (TSMS) is a counter that controls the switching function (DCP) from phase one to phase two. The actual switch (TX) activates DCP based upon the condition of CRTR and PVTR of Figures 3c and 3e, respectively (see Figure 3f).

H. Programs. The model treats two single programs, one of a high priority and the other of a low priority. Each is modeled in two phases to represent any two contiguous phases of the weapon system development.

I. Constants. Table 14 lists the constants that can easily be altered when running the model. An "X" in the table indicates that the constant can be altered for each program but may not be different from phase to phase.

J. Measure of Effectiveness. The measure of effectiveness (MOE) used for the model is based upon cost, schedule, performance, priority, and SPO funding levels. The data collected in the surveys were integrated into a MOE

TABLE 14

CONSTANTS IN THE MODEL

High Priority		Low Priority		
Phase 1	Phase 2	Phase 1	Phase 2	Basic Run Values
TCF	X	XTCF	X	1
SPDE1	SPDE2	XSPDE1	XSPDE2	1
EDCE	X	XEDCE	X	18
RGCE	X	XRGCE	X	12
YRDCE	X	XYRDCE	X	20
GSNC	X	XGSNC	X	0.1
ED1C	ED2C	XED1C	XED2C	16
RG1C	RG2C	XRG1C	XRG2C	9
YRD1C	YRD2C	XYRD1C	XYRD2C	0
APD1	APD2	XAPD1	XAPD2	.05
CE1	CE2	XCE1	XCE2	1
PRIA	X	PRIX	X	1 & 5
DOLH	X	DOLL	X	100

function for each of the two phases of each SPO along with the model responses of cost, schedule, and performance. Measures of effectiveness were determined for the individual SPOs and these were summed for a total "organizational" MOE.

ASD ASSIGNMENT POLICY MODEL

```
NOTE*****WEAPON SYSTEM DEVELOPMENT*************
NOTE*****************PHASE1********************
NOTE******THIS IS THE FIRST PHASE FOR THE HIGHER PRIORITY PROGRAM AND
NOTE******IS NOTED BY THE POSTSCRIPT 1.
L    AP1.K=AP1.J+DT(APR1.JK)
NOTE******AP=ACTUAL PROGRESS
NOTE******THE 1 REPRESENTS PHASE 1.
N    AP1=0
R    APR1.KL=APRR11.K
NOTE******APR=ACTUAL PROGRESS RATE
N    APRR11=0
A    APRR11.K=TE1.K*PGM1.K*SPD1.K*FUNDS1.K
NOTE******APRR11=ACTUAL PROGRESS RATE SUMMATION FACTOR.
NOTE******TE=TECH/MANAGEMENT FACTOR
NOTE******PGM=PROGRAM PLAN
NOTE******SPD=SPO DIRECTOR INFLUENCE
NOTE******FUNDS=FUNDING CHANGE
A    TE1.K=TCF*ME1.K
NOTE******TCF=TECHNICAL COMPLEXITY FACTOR
NOTE******ME=MANAGEMENT EFFECT OF PERSONS ASSIGNED
C    TCF=1
NOTE*************TCF CAN BE CHANGED.
A    DTC1.K=TABHL(TDTC,PAP1.K-CR1.K,-1,1,1)*DTCT1.K
A    DTCT1.K=TABHL(TDTCT,SPDE1,0,2,2)
T    TDTCT=.525/1.43
NOTE******DTC=SPO DIRECTOR'S DESIRE TO CHANGE THE SITUATION
NOTE******TDTC=TABHL FUNCTION OF DTC
NOTE******PAP=PERCEIVED ACTUAL PROGRESS
NOTE******CR=COSTS REPORTED
NOTE******DTCT=SPO DIRECTOR'S DESIRE TO CHANGE PROGRESS
NOTE******TDTCT=TABLE FUNCTION OF DTCT
T    TDTC=2/1/0
C    SPDE1=1
NOTE*************SPDE1 CAN BE CHANGED.
NOTE******SPDE=SPO DIRECTOR'S EFFECT ON CHANGE
A    SPDI1.K=TABHL(TSPDI,SPDE1,0,2,1)
NOTE******SPDI=SPO DIRECTOR'S INFLUENCE DUE TO EFFECTIVENESS
NOTE******SP[illegible]=TABLE FUNCTION OF SPDI
T    TSPDI=.375/1/1.325
A    SPDTI1.K=DTC1.K*SPDI1.K
NOTE******SPTI=SPO DIRECTOR'S TOTAL EFFECT ON CHANGE
NOTE******TSPDI=TABLE FUNCTION OF SPTI
A    SPD1.K=DELAY3(SPDTI1.K,1)
NOTE******SPD=DELAYED SPO DIRECTOR'S TOTAL INFLUENCE ON CHANGE
```

```
450.0000 A    FUN1.K=TABHL(TFUN,CRPA1.K,0,4,4)
[illegible]◆◆◆◆◆◆FUN=FUNDS DESIRED DUE TO SPENDING PATTERN
470.0000 NOTE◆◆◆◆◆◆TFUN=TABLE FUNCTION OF FUNDS
480.0000 T    TFUN=.49/1.24
490.0000 A    FUNDS1.K=DELAY3(FUN1.K,FDEL.K)
500.0000 A    FDEL.K=TABHL(TFDEL,PRIA,1,5,4)
510.0000 T    TFDEL=4.4/15
520.0000 NOTE◆◆◆◆◆◆FUNDS=DELAYED FUNDS FUNCTION
530.0000 NOTE◆◆◆◆◆◆FDEL=FUNDS DELAY
540.0000 NOTE◆◆◆◆◆◆TFDEL=TABLE FUNCTION OF FDEL
550.0000 A    ME1.K=E1.K
560.0000 NOTE◆◆◆◆◆◆E=EXPERIENCE FACTOR TOTAL
570.0000 A    E1.K=(YRDF1.K◆RGF1.K◆EDF1.K)◆G3N.K+(EDF.K◆RGF.K◆YRDF.K)◆G3E.K
580.0000 NOTE◆◆◆◆◆◆YRDF=YEARS OF R AND D EXPERINCE FACTOR
590.0000 NOTE◆◆◆◆◆◆RGF=RANK OR GRADE FACTOR
600.0000 NOTE◆◆◆◆◆◆EDF=EDUCATION FACTOR
610.0000 C    EDCE=18
620.0000 C    RGCE=12
630.0000 C    YRDCE=20
640.0000 NOTE◆◆◆◆◆◆EDCE=EDUCATION LEVEL OF EXPERIENCED PERSONNEL
650.0000 NOTE◆◆◆◆◆◆RGCE=RANK OR GRADE OF EXPERIENCED PERSONNEL
660.0000 NOTE◆◆◆◆◆◆YRDCE=YEARS OF R AND D OF EXPERIENCED PERSONNEL
670.0000 NOTE◆◆◆◆◆◆EDCE,RGCE,AND YRDCE CAN BE CHANGED.
680.0000 A    EDF.K=TABHL(EDF1T,EDCE,12,20,2)
690.0000 A    RGF.K=TABHL(RGF1T,RGCE,9,14,1)
700.0000 A    YRDF.K=TABHL(YRD1FT,YRDCE,0,20,4)
710.[illegible] A    [illegible]=G3N.K
720.0000 NOTE◆◆◆◆◆◆G3E=FRACTION OF EXPERIENCED PERSONNEL IN THE SPO
730.0000 NOTE◆◆◆◆◆◆G3N=FRACTION OF INEXPERIENCED PERSONNEL IN THE SPO
740.0000 A    G3N.K=G3NC
750.0000 C    G3NC=.1
760.0000 A    ED1.K=ED1C
770.0000 C    ED1C=16
780.0000 NOTE◆◆◆◆◆◆ED1C=EDUCATIONAL LEVEL IN YEARS OF INEXPERIENCED PERSONNEL
790.0000 NOTE◆◆◆◆◆◆◆◆◆◆◆◆◆ED1C CAN BE CHANGED.
800.0000 NOTE◆◆◆◆◆◆ED1C=EDUCATION LEVEL FACTOR CONSTANT
810.0000 A    RG1.K=RG1C
820.0000 C    RG1C=9
830.0000 NOTE◆◆◆◆◆◆RG1C=RANK OR GRADE OF THE INEXPERIENCED PERSONNEL
840.0000 NOTE◆◆◆◆◆◆◆◆◆◆◆◆◆RG1C CAN BE CHANGED.
850.0000 NOTE◆◆◆◆◆◆RG1C=RANK OR GRADE LEVEL FACTOR CONSTANT
860.0000 A    YRD1.K=YRD1C
870.0000 C    YRD1C=0
880.0000 NOTE◆◆◆◆◆◆YRD1C=YEARS OF R AND D OF INEXPERIENCED PERSONNEL
890.0000 NOTE◆◆◆◆◆◆◆◆◆◆◆◆◆YRD1C CAN BE CHANGED.
900.0000 NOTE◆◆◆◆◆◆YRD1C=YEARS OF R AND D LEVEL FACTOR CONSTANT
```

```
910.0000 A    EDF1.K=TABHL(EDF1T,ED1.K,12,20,2)
920.0000 NOTE******EDF=EDUCATION VS. PERFORMANCE TABLE
930.0000 T    EDF1T=.57/.695/.84/1/.89
940.0000 A    RGF1.K=TABHL(RGF1T,RG1.K,9,14,1)
950.0000 NOTE******RGF=RANK OR GRADE VS. PERFROMANCE TABLE
960.0000 T    RGF1T=.75/.82/.9/1/.995/.95
970.0000 A    YRDF1.K=TABHL(YRD1FT,YRD1.K,0,20,4)
980.0000 NOTE******YRDF=YEARS OF R AND D VS. PERFORMANCE TABLE
990.0000 T    YRD1FT=.45/.62/.82/.9/.95/1
1000.0000 A    PGM1.K=TABHL(PGM1T,SCHED1.K,0,36,3)
1010.0000 NOTE******PGM=PROGRAM VS. SCHEDULE TABLE
1020.0000 A    SCHED1.K=TSMSO.K
1030.0000 A    PAP1.K=DELAY1(AP1.K,APD1)
1040.0000 NOTE******PAP=PERCEIVED ACTUAL PROGRESS DELAYED
1050.0000 NOTE******AP=ACTUAL PROGRESS
1060.0000 NOTE******APD=ACTUAL PROGRESS DELAY
1070.0000 C    APD1=4.6
1080.0000 NOTE*************APD1 CAN BE CHANGED.
1090.0000 A    RTTMS1.K=(TSMSO.K-PAT1.K+TTMS1.K)
1100.0000 NOTE******RTTMS=TIME REMAINING TO MILESTONE
1110.0000 NOTE******TSMSO=TIME SINCE MILESTONE ZERO
1120.0000 NOTE******TTMS1=TIME SINCE MILESTONE ONE
1130.0000 A    PAT1.K=TABHL(PAT1T,PAP1.K,0,100,20)
1140.0000 NOTE******PAT=PERCEIVED ACTUAL TIME VS. PERCEIVED ACTUAL PROGRESS
1150.0000 T    PAT1T=0/3/5.5/7.6/9.8/11
1160.0000 A    TTMS1.K=36-TSMSO.K
1170.0000 L    PP1.K=PP1.J+DT(PPGM1.JK)
1180.0000 NOTE******PP=PLANNED PROGRESS
1190.0000 N    PP1=.01
1200.0000 R    PPGM1.KL=TABHL(PGM1T,PSCHD1.K,0,36,3)
1210.0000 NOTE******PPGM=PLANNED PROGRAM
1220.0000 T    PGM1T=0/1.388/2.77/2.77/2.77/2.77/2.77/2.77/2.77/
1230.0000 X    2.77/2.77/4.165/5.55
1240.0000 A    PSCHD1.K=TSMSO.K
1250.0000 NOTE******PLANNED SCHEDULE
1260.0000 L    CR1.K=CR1.J+DT*(CRR1.JK-CRTR1.JK)
1270.0000 NOTE******CR=COSTS REPORTED
1280.0000 NOTE******CRR=COSTS REPORTED RATE
1290.0000 NOTE******CRTR=COSTS REPORTED DELETION FACTOR RATE
1300.0000 N    CR1=CR1C
1310.0000 C    CR1C=.01
1320.0000 R    CRR1.KL=(1/SPD1.K)*CE1*PGM1.K
1330.0000 NOTE******SPD1=DELAYED SPO DIRECTOR'S TOTAL INFLUENCE ON CHANGE.
?1340.0000 NOTE******CE=COST ESTIMATING FACTOR
1350.0000 C    CE1=1
1360.0000 NOTE*************CE1 CAN BE CHANGED.
1370.0000 R    CRTR1.KL=CR1.K*TX1.K
1380.0000 L    PC1.K=PC1.J+DT*(PCR1.JK-PCTR1.JK)
1390.0000 NOTE******PC=PLANNED COSTS
1400.0000 NOTE******PCR=PLANNED COSTS RATE
```

```
NOTE******PCTR=PLANNED COSTS DELETION FACTOR RATE
N    PC1=PC1C
C    PC1C=.01
R    PCR1.KL=(PPGM1.JK)
R    PCTR1.KL=0
A    PRAP1.K=PAP1.K/PP1.K
NOTE******PRAP=PERCEIVED VS. PLANNED PROGRESS RATIO
A    CRPA1.K=PC1.K/CR1.K
NOTE******CRPA=PLANNED COSTS VS. COSTS REPORTED RATIO
L    PV1.K=PV1.J+DT(PVR1.JK-PVTR1.JK)
NOTE******PV=PROGRAM VALUE (PERFORMANCE)
NOTE******PVR=PROGRAM VALUE RATE
NOTE******PVTR=PROGRAM VALUE DELETION FACTOR RATE
N    PV1=0
R    PVR1.KL=PPVS1.K*PVA1.K
A    PPVS1.K=PPGM1.JK
NOTE******PPVS=PLANNED PROGRAM VALUE FROM THE SCHEDULE
A    PVA1.K=PRAP1.K*CRPA1.K
NOTE******PVA=PROGRAM VALUE FACTOR (PROGRESS/COST RATIOS)
R    PVTR1.KL=PV1.K*TX1.K
NOTE******TX=SWITCHING FUNCTION
L    TSMSO.K=TSMSO.J+DT(TIN1.JK)
NOTE******TSMSO=TIME SINCE MILESTONE ZERO (COUNTER)
NOTE******TIN=TIME IN PERIODS OF ONE (RATE)
N    TSMSO=0
R    TIN1.KL=1
A    DCP1.K=SWITCH(0,1,RTTMS1.K)
NOTE******DCP=SWITCHING FUNCTION FOR COUNTER
A    TX1.K=SWITCH(1,0,DCP1.K)
NOTE*****************PHASE2*********************
NOTE******PHASE 2 IS SHOWN WITH THE POSTSCRIPT 2
L    AP2.K=AP2.J+DT(APR2.JK)
N    AP2=0
R    APR2.KL=APRR22.K*CLP.K
N    APRR22=0
A    APRR22.K=TE2.K*PGM2.K*SPD2.K*FUNDS2.K
A    TE2.K=TCF*ME2.K
A    DTC2.K=TABHL(TDTC,PAP2.K-CR2.K,-1,1,1)*DTCT2.K
A    DTCT2.K=TABHL(TDTCT,SPDE2,0,2,2)
C    SPDE2=1
NOTE*************SPDE2 CAN BE CHANGED.
A    SPDI2.K=TABHL(TSPDI,SPDE2,0,2,1)
A    SPDTI2.K=DTC2.K*SPDI2.K
A    SPD2.K=DELAY3(SPDTI2.K,1)
A    FUN2.K=TABHL(TFUN,CRPA2.K,0,4,4)
A    FUNDS2.K=DELAY3(FUN2.K,FDEL.K)
A    ME2.K=E2.K
A    E2.K=(YRDF2.K*RGF2.K*EDF2.K)*GSN.K+(EDF.K*RGF.K*YRDF.K)*GSE.K
A    ED2.K=ED2C
C    ED2C=16
```

```
1910.0000 NOTE*************ED2C CAN BE CHANGED.
1920.0000 A    RG2.K=RG2C
1930.0000 C    RG2C=9
1940.0000 NOTE*************RG2C CAN BE CHANGED.
1950.0000 A    YRD2.K=YRD2C
1960.0000 C    YRD2C=0
1970.0000 NOTE*************YRD2C CAN BE CHANGED.
1980.0000 A    EDF2.K=TABHL(EDF1T,ED2.K,12,20,2)
1990.0000 A    RGF2.K=TABHL(RGF1T,RG2.K,9,14,1)
2000.0000 A    YRDF2.K=TABHL(YRD1FT,YRD2.K,0,20,4)
2010.0000 A    PGM2.K=TABHL(PGM2T,SCHED2.K,0,36,3)
2020.0000 A    SCHED2.K=TSMS1.K
2030.0000 A    PAP2.K=DELAY1(AP2.K,APD2)
2040.0000 C    APD2=4.6
2050.0000 NOTE*************APD2 CAN BE CHANGED.
2060.0000 A    RTTMS2.K=(TSMS1.K-PAT2.K+TTMS2.K)
2070.0000 A    PAT2.K=TABHL(PAT2T,PAP2.K,0,100,20)
2080.0000 T    PAT2T=0/3/5.5/7.6/9.8/11
2090.0000 A    TTMS2.K=36-TSMS1.K
2100.0000 L    PP2.K=PP2.J+DT(PPGM2.JK)
2110.0000 N    PP2=.01
2120.0000 R    PPGM2.KL=TABHL(PGM2T,PSCHD2.K,0,36,3)*CLPP.K
2130.0000 T    PGM2T=0/1.388/2.77/2.77/2.77/2.77/2.77/2.77/2.77/
2140.0000 X    2.77/2.77/4.165/5.55
2150.0000 A    PSCHD2.K=TSMS1.K
2160.0000 L    CR2.K=CR2.J+DT*(CRR2.JK-CRTR2.JK)
2170.0000 N    CR2=CR2C
2180.0000 C    CR2C=.01
2190.0000 R    CRR2.KL=((1/SPD2.K)*CE2*PGM2.K)*CLP.K
2200.0000 C    CE2=1
2210.0000 NOTE*************CE2 CAN BE CHANGED.
2220.0000 R    CRTR2.KL=CR2.K*TX2.K
2230.0000 L    PC2.K=PC2.J+DT*(PCR2.JK-PCTR2.JK)
2240.0000 N    PC2=PC2C
2250.0000 C    PC2C=.01
2260.0000 R    PCR2.KL=(PPGM2.JK)
2270.0000 R    PCTR2.KL=0
2280.0000 A    PRAP2.K=PAP2.K/PP2.K
2290.0000 A    CRPA2.K=PC2.K/CR2.K
2300.0000 L    PV2.K=PV2.J+DT(PVR2.JK-PVTR2.JK)
2310.0000 N    PV2=0
2320.0000 R    PVR2.KL=PPVS2.K*PVA2.K
2330.0000 A    PPVS2.K=PPGM2.JK
2340.0000 A    PVA2.K=PRAP2.K*CRPA2.K
2350.0000 R    PVTR2.KL=PV2.K*TX2.K
2360.0000 L    TSMS1.K=TSMS1.J+DT(TIN2.JK)
2370.0000 N    TSMS1=0
2380.0000 R    TIN2.KL=1*CLP.K
2390.0000 A    DCP2.K=SWITCH(0,1,RTTMS2.K)
2400.0000 A    TX2.K=SWITCH(1,0,DCP2.K)
```

```
2410.0000 A    PP11.K=MIN(PP1.K,100)
2420.0000 NOTE******THIS FACTOR ASSURES A LIMIT OF 100 PERCENT FOR PP
2430.0000 A    PP22.K=MIN(PP2.K,100)
2440.0000 A    AP11.K=MIN(AP1.K,100)
2450.0000 A    AP22.K=MIN(AP2.K,100)
2460.0000 A    CR11.K=MIN(CR1.K,100)
2470.0000 A    CR22.K=MIN(CR2.K,100)
2480.0000 A    PC11.K=MIN(PC1.K,100)
2490.0000 A    PC22.K=MIN(PC2.K,100)
2500.0000 A    PV11.K=MIN(PV1.K,100)
2510.0000 A    PV22.K=MIN(PV2.K,100)
2520.0000 A    CLP.K=CLIP(1,0,PAP1.K,100)
2530.0000 A    CLPP.K=CLIP(1,0,PP1.K,100)
2540.0000 NOTE************THE FOLLOWING EQUATIONS REFER TO A LOWER
2550.0000 NOTE****PRIORITY SPO THAN THE ABOVE CASE.
2560.0000 NOTE*****************PHASE 1***************************
2570.0000 NOTE******THIS LOWER PRIORITY PROGRAM IS PRESCRIPTED WITH X.
2580.0000 NOTE******PHASE ONE IS POSTSCRIPTED WITH THE 1.
2590.0000 L    XAP1.K=XAP1.J+DT(XAPR1.JK)
2600.0000 N    XAP1=0
2610.0000 R    XAPR1.KL=XAPRR11.K
2620.0000 N    XAPRR11=0
2630.0000 A    XAPRR11.K=XTE1.K*XPGM1.K*XSPD1.K*XFUNDS1.K
2640.0000 A    XTE1.K=XTCF*XME1.K
2650.0000 C    XTCF=1
2660.0000 NOTE*************XTCF CAN BE CHANGED.
2670.0000 A    XDTC1.K=TABHL(TDTC,XPAP1.K-XCR1.K,-1,1,1)*XDTCT1.K
2680.0000 A    XDTCT1.K=TABHL(TDTCT,XSPDE1,0,2,2)
2690.0000 C    XSPDE1=1
2700.0000 NOTE*************XSPDE1 CAN BE CHANGED.
2710.0000 A    XSPDI1.K=TABHL(TSPDI,XSPDE1,0,2,1)
2720.0000 A    XSPDTI1.K=XDTC1.K*XSPDI1.K
2730.0000 A    XSPD1.K=DELAY3(XSPDTI1.K,1)
2740.0000 A    XFUN1.K=TABHL(TFUN,XCRPA1.K,0,4,4)
2750.0000 A    XFUNDS1.K=DELAY3(XFUN1.K,XFDEL.K)
2760.0000 A    XFDEL.K=TABHL(TFDEL,PRIX,1,5,4)
2770.0000 A    XME1.K=XE1.K
2780.0000 A    XE1.K=XEDF1.K*XRGF1.K*XYRDF1.K*XGSN.K+XEDF.K*XRGF.K*XYRDF.K*XGSE.
2790.0000 A    XGSE.K=1-XGSN.K
2800.0000 A    XGSN.K=XGSNC
2810.0000 C    XGSNC=.3
2820.0000 A    XEDF.K=TABHL(EDF1T,XEDCE,12,20,2)
2830.0000 A    XRGF.K=TABHL(RGF1T,XRGCE,9,14,1)
2840.0000 A    XYRDF.K=TABHL(YRD1FT,XYRDCE,0,20,4)
2850.0000 C    XEDCE=18
2860.0000 C    XRGCE=12
2870.0000 C    XYRDCE=20
2880.0000 A    XED1.K=XED1C
2890.0000 C    XED1C=16
2900.0000 NOTE*************XED1C CAN BE CHANGED.
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```
2910.0000 A    XRG1.K=XRG1C
2920.0000 C    XRG1C=9
2930.0000 NOTE*************XRG1C CAN BE CHANGED.
2940.0000 A    XYRD1.K=XYRD1C
2950.0000 C    XYRD1C=0
2960.0000 NOTE*************XYRD1C CAN BE CHANGED.
2970.0000 A    XEDF1.K=TABHL(EDF1T,XED1.K,12,20,2)
2980.0000 A    XRGF1.K=TABHL(RGF1T,XRG1.K,9,14,1)
2990.0000 A    XYRDF1.K=TABHL(YRD1FT,XYRD1.K,0,20,4)
3000.0000 A    XPGM1.K=TABHL(XPGM1T,XSCHED1.K,0,36,3)
3010.0000 A    XSCHED1.K=XTSMSD.K
3020.0000 A    XPAP1.K=DELAY1(XAP1.K,XAPD1)
3030.0000 C    XAPD1=4.6
3040.0000 NOTE************XAPD1 CAN BE CHANGED.
3050.0000 A    XRTTMS1.K=(XTSMSD.K-XPAT1.K+XTTMS1.K)
3060.0000 A    XPAT1.K=TABHL(XPAT1T,XPAP1.K,0,100,20)
3070.0000 T    XPAT1T=0/3/5.5/7.6/9.8/11
3080.0000 A    XTTMS1.K=36-XTSMSD.K
3090.0000 L    XPP1.K=XPP1.J+DT(XPPGM1.JK)
3100.0000 N    XPP1=.01
3110.0000 R    XPPGM1.KL=TABHL(XPGM1T,XPSCHD1.K,0,36,3)
3120.0000 T    XPGM1T=0/1.388/2.77/2.77/2.77/2.77/2.77/2.77/2.77/
3130.0000 X    2.77/2.77/4.165/5.55
3140.0000 A    XPSCHD1.K=XTSMSD.K
3150.0000 L    XCR1.K=XCR1.J+DT*(XCRR1.JK-XCRTR1.JK)
3160.0000 N    XCR1=XCR1C
3170.0000 C    XCR1C=.01
3180.0000 R    XCRR1.KL=(1/XSPD1.K)*XCE1*XPGM1.K
3190.0000 C    XCE1=1
3200.0000 NOTE*************XCE1 CAN BE CHANGED.
3210.0000 R    XCRTR1.KL=XCR1.K*XTX1.K
3220.0000 L    XPC1.K=XPC1.J+DT(XPCR1.JK-XPCTR1.JK)
3230.0000 N    XPC1=XPC1C
3240.0000 C    XPC1C=.01
3250.0000 R    XPCR1.KL=(XPPGM1.JK)
3260.0000 R    XPCTR1.KL=0
3270.0000 A    XPRAP1.K=XPAP1.K/XPP1.K
3280.0000 A    XCRPA1.K=XPC1.K/XCR1.K
3290.0000 L    XPV1.K=XPV1.J+DT(XPVR1.JK-XPVTR1.JK)
3300.0000 N    XPV1=0
3310.0000 R    XPVR1.KL=XPPVS1.K*XPVA1.K
3320.0000 A    XPPVS1.K=XPPGM1.JK
3330.0000 A    XPVA1.K=XPRAP1.K*XCRPA1.K
3340.0000 R    XPVTR1.KL=XPV1.K*XTX1.K
3350.0000 L    XTSMSD.K=XTSMSD.J+DT(XTIN1.JK)
3360.0000 N    XTSMSD=0
3370.0000 R    XTIN1.KL=1
3380.0000 A    XDCP1.K=SWITCH(0,1,XRTTMS1.K)
3390.0000 A    XTX1.K=SWITCH(1,0,XDCP1.K)
```

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3400.0000 NOTE****************PHASE 2*******************
3410.0000 L    XAP2.K=XAP2.J+DT(XAPR2.JK)
3420.0000 N    XAP2=0
3430.0000 R    XAPR2.KL=XAPRR22.K*XCLP.K
3440.0000 N    XAPRR22=0
3450.0000 A    XAPRR22.K=XTE2.K*XPGM2.K*XSPD2.K*XFUNDS2.K
3460.0000 A    XTE2.K=XTCF*XME2.K
3470.0000 A    XDTC2.K=TABHL(TDTC,XPAP2.K-XCR2.K,-1,1,1)*XDTCT2.K
3480.0000 A    XDTCT2.K=TABHL(TDTCT,SPDE2,0,2,2)
3490.0000 C    XSPDE2=1
3500.0000 NOTE*************XSPDE2 CAN BE CHANGED.
3510.0000 A    XSPDI2.K=TABHL(TSPDI,XSPDE2,0,2,1)
3520.0000 A    XSPDTI2.K=XDTC2.K*XSPDI2.K
3530.0000 A    XSPD2.K=DELAY3(XSPDTI2.K,1)
3540.0000 A    XFUN2.K=TABHL(TFUN,XCRPA2.K,0,4,4)
3550.0000 A    XFUNDS2.K=DELAY3(XFUN2.K,XFDEL.K)
3560.0000 A    XME2.K=XE2.K
3570.0000 A    XE2.K=XEDF2.K*XRGF2.K*XYRDF2.K*XGSN.K+XEDF.K*XRGF.K*XYRDF.K*XGSE.K
3580.0000 A    XED2.K=XED2C
3590.0000 C    XED2C=16
3600.0000 NOTE*************XED2C CAN BE CHANGED.
3610.0000 A    XRG2.K=XRG2C
3620.0000 C    XRG2C=9
3630.0000 NOTE*************XRG2C CAN BE CHANGED.
3640.0000 A    XYRD2.K=XYRD2C
3650.0000 C    XYRD2C=0
3660.0000 NOTE*************XYRD2C CAN BE CHANGED.
3670.0000 A    XEDF2.K=TABHL(EDF1T,XED2.K,12,20,2)
3680.0000 A    XRGF2.K=TABHL(RGF1T,XRG2.K,9,14,1)
3690.0000 A    XYRDF2.K=TABHL(YRD1FT,XYRD2.K,0,20,4)
3700.0000 A    XPGM2.K=TABHL(XPGM2T,XSCHED2.K,0,36,3)
3710.0000 A    XSCHED2.K=XTSMS1.K
3720.0000 A    XPAP2.K=DELAY1(XAP2.K,XAPD2)
3730.0000 C    XAPD2=4.6
3740.0000 NOTE*************XAPD2 CAN BE CHANGED.
3750.0000 A    XRTTMS2.K=(XTSMS1.K-XPAT2.K+XTTMS2.K)
3760.0000 A    XPAT2.K=TABHL(XPAT2T,XPAP2.K,0,100,20)
3770.0000 T    XPAT2T=0/3/5.5/7.6/9.8/11
3780.0000 A    XTTMS2.K=36-XTSMS1.K
3790.0000 L    XPP2.K=XPP2.J+DT(XPPGM2.JK)
3800.0000 N    XPP2=.01
3810.0000 R    XPPGM2.KL=TABHL(XPGM2T,XPSCHD2.K,0,36,3)*XCLPP.K
3820.0000 T    XPGM2T=0/1.388/2.77/2.77/2.77/2.77/2.77/2.77/2.77/
3830.0000 X    2.77/2.77/4.165/5.55
3840.0000 A    XPSCHD2.K=XTSMS1.K
3850.0000 L    XCR2.K=XCR2.J+DT(XCRR2.JK-XCRTR2.JK)
3860.0000 N    XCR2=XCR2C
3870.0000 C    XCR2C=.01
3880.0000 R    XCRR2.KL=((1/XSPD2.K)*XCE2*XPGM2.K)*XCLP.K
3890.0000 C    XCE2=1
3900.0000 NOTE*************XCE2 CAN BE CHANGED.
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3910.0000 R    XCRTR2.KL=XCR2.K*XTX2.K
3920.0000 L    XPC2.K=XPC2.J+DT(XPCR2.JK-XPCTR2.JK)
3930.0000 N    XPC2=XPC2C
3940.0000 C    XPC2C=.01
3950.0000 R    XPCR2.KL=(XPPGM2.JK)
3960.0000 R    XPCTR2.KL=0
3970.0000 A    XPRAP2.K=XPAP2.K/XPP2.K
3980.0000 A    XCRPA2.K=XPC2.K/XCR2.K
3990.0000 L    XPV2.K=XPV2.J+DT(XPVR2.JK-XPVTR2.JK)
4000.0000 N    XPV2=0
4010.0000 R    XPVR2.KL=XPPVS2.K*XPVA2.K
4020.0000 A    XPPVS2.K=XPPGM2.JK
4030.0000 A    XPVA2.K=XPRAP2.K*XCRPA2.K
4040.0000 R    XPVTR2.KL=XPV2.K*XTX2.K
4050.0000 L    XTSMS1.K=XTSMS1.J+DT(XTIN2.JK)
4060.0000 N    XTSMS1=0
4070.0000 R    XTIN2.KL=1*XCLP.K
4080.0000 A    XDCP2.K=SWITCH(0,1,XRTTMS2.K)
4090.0000 A    XTX2.K=SWITCH(1,0,XDCP2.K)
4100.0000 A    XPP11.K=MIN(XPP1.K,100)
4110.0000 A    XPP22.K=MIN(XPP2.K,100)
4120.0000 A    XAP11.K=MIN(XAP1.K,100)
4130.0000 A    XAP22.K=MIN(XAP2.K,100)
4140.0000 A    XCR11.K=MIN(XCR1.K,100)
4150.0000 A    XCR22.K=MIN(XCR2.K,100)
4160.0000 A    XPC11.K=MIN(XPC1.K,100)
4170.0000 A    XPC22.K=MIN(XPC2.K,100)
4180.0000 A    XPV11.K=MIN(XPV1.K,100)
4190.0000 A    XPV22.K=MIN(XPV2.K,100)
4200.0000 A    XCLP.K=CLIP(1,0,XPAP1.K,100)
4210.0000 A    XCLPP.K=CLIP(1,0,XPP1.K,100)
4220.0000 NOTE******THE FOLLOWING EQUATIONS ARE USED TO DETERMINE A MEASURE
4230.0000 NOTE******OF EFFECTIVENESS (MOE) FOR EACH OF THE PROGRAMS IN EACH
4240.0000 NOTE******OF THE TWO PHASES AND A MOE FOR THE TWO PHASE TWO SPO
4250.0000 NOTE******ORGANIZATION.
4260.0000 C    PRIA=1
4270.0000 NOTE*************PRIA CAN BE CHANGED.
4280.0000 NOTE******PRIA=PRIORITY OF THE HIGH PRIORITY PROGRAM
4290.0000 C    PRIX=5
4300.0000 NOTE*************PRIX CAN BE CHANGED.
4310.0000 NOTE******PRIX=PRIORITY OF THE LOWER PRIORITY PROGRAM
4320.0000 A    PRTA.K=1/PRIA
4330.0000 A    PRTX.K=1/PRIX
4340.0000 A    VAL11.K=DOLH*PRTA.K*CLLP.K*(1/VCOST1.K)*VPERF1.K*VSCH1.K
4350.0000 NOTE******VAL11=THE VALUE OF THE HIGH PRIORITY PROGRAM IN PHASE ONE.
4360.0000 C    DOLH=100
4370.0000 NOTE******DOLH=DOLLAR VALUE(BUDGET) OF HI. PRI. PROG.
4380.0000 NOTE******CLLP=CLIP FUNCTION
4390.0000 NOTE******VCOST1=COST FACTOR VALUE
4400.0000 NOTE******VPERF1=PERFORMANCE FACTOR VALUE
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NOTE******VSCH1=SCHEDULE FACTOR VALUE
A    VCOST1.K=TABHL(TVCOST,CRPA1.K,0,2,.5)
T    TVCOST=.001/.013/.078/.096/.11
A    VPERF1.K=TABHL(TVPERF,PVA1.K,0,2,.5)
T    TVPERF=.069/.076/.084/.084/.086
A    VSCH1.K=TABHL(TVSCH,PRAP1.K,0,2,.5)
T    TVSCH=.051/.052/.063/.065/.071
NOTE******VCOST=THE CONTRIBUTION OF COST TO THE MOE
NOTE******VPERF=THE CONTRIBUTION OF PERFORMANCE TO THE MOE
NOTE******VSCH=THE CONTRIBUTION OF SCHEDULE TO THE MOE
A    CLLP.K=CLIP(100,AP1.K,AP1.K,100)
A    CLLP2.K=CLIP(100,AP2.K,AP2.K,100)
A    XCLLP.K=CLIP(100,XAP1.K,XAP1.K,100)
A    XCLLP2.K=CLIP(100,XAP2.K,XAP2.K,100)
A    VAL12.K=DOLH*PRTA.K*CLLP2.K*(1/VCOST2.K)*VPERF2.K*VSCH2.K
NOTE*****VAL12=THE VALUE OF THE HIGH PRIORITY PROGRAM IN PHASE TWO
A    VCOST2.K=TABHL(TVCOST,CRPA2.K,0,2,.5)
A    VPERF2.K=TABHL(TVPERF,PVA2.K,0,2,.5)
A    VSCH2.K=TABHL(TVSCH,PRAP2.K,0,2,.5)
A    VALX1.K=DOLL*PRTX.K*XCLLP.K*(1/VXCOST1.K)*VXPERF1.K*VXSCH1.K
NOTE******VALX1=THE VALUE OF THE LOW PRIORITY PROGRAM IN PHASE ONE
C    DOLL=100
NOTE******DOLL=DOLLAR VALUE(BUDGET) OF LOW PRIORITY PROGRAM
A    VXCOST1.K=TABHL(TVCOST,XCRPA1.K,0,2,.5)
A    VXPERF1.K=TABHL(TVPERF,XPVA1.K,0,2,.5)
A    VXSCH1.K=TABHL(TVSCH,XPRAP1.K,0,2,.5)
A    VALX2.K=DOLL*PRTX.K*XCLLP2.K*(1/VXCOST2.K)*VXPERF2.K*VXSCH2.K
NOTE******VALX2=THE VALUE OF THE LOWER PRIORITY PROGRAM IN PHASE TWO
A    VXCOST2.K=TABHL(TVCOST,XCRPA2.K,0,2,.5)
A    VXPERF2.K=TABHL(TVPERF,XPVA2.K,0,2,.5)
A    VXSCH2.K=TABHL(TVSCH,XPRAP2.K,0,2,.5)
A    VALT1.K=VAL11.K+VALX1.K
NOTE******VALT1=THE TOTAL VALUE OF BOTH PROGRAMS IN PHASE ONE
A    VALT2.K=VAL12.K+VALX2.K
NOTE******VALT2=THE TOTAL VALUE OF BOTH PROGRAMS IN PHASE TWO
A    VALTT.K=VALT1.K+VALT2.K
NOTE******VALTT=THE TOTAL VALUE FOR BOTH PROGRAMS IN BOTH PHASES
NOTE******THE FOLLOWING ARE THE CONTROL STATEMENT THAT DETERMINE
NOTE******THE LENGTH OF THE SIMULATION AND THE DATA THAT IS PLOTTED
NOTE******AND THE TABLES THAT ARE PRINTED.
SPEC DT=.05
SPEC LENGTH=200
SPEC PLTPER=0
SPEC PRTPER=50
PLOT VAL11/VAL12/VALX1/VALX2/VALT1/VALT2/VALTT
PLOT XAP11,XAP22,XPP11,XPP22
X     XCR11,XPC11,XCR22,XPC22,XPV11,XPV22
PLOT AP11,AP22,PP11,PP22,CR11,PC11,CR22,PC22,PV11,PV22
PRINT VAL11,VAL12,VALX1,VALX2,VALTT
```

APPENDIX B

COMPUTER RESULTS

PAGE 3 FILE BS6 01/03/83

	GSNC	XGSNC
PRESENT	0.	1.000
ORIGINAL	.1000	.3000

PAGE 4 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.000	.000	.0
49.99	632.54	130.18	59.697	.000	822.4
99.98	665.74	643.25	77.930	33.768	1420.7
149.97	672.47	664.99	78.384	77.704	1493.5
199.95	675.38	670.55	78.594	78.305	1502.8

PAGE 6 FILE BS6 01/03/83

	GSNC	XGSNC
PRESENT	62.50A	.7500
ORIGINAL	.1000	.3000

PAGE 7 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.000	.000	.0
49.99	604.26	110.34	87.057	.000	801.7
99.98	645.57	626.77	90.382	87.061	1449.8
149.97	653.98	650.66	90.965	90.385	1486.0
199.95	657.47	656.09	91.195	90.964	1495.7

PAGE 9 FILE BS6 01/03/83

	GSNC	XGSNC
PRESENT	.1250	.5000
ORIGINAL	.1000	.3000

PAGE 10 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	581.07	88.53	97.19	2.22	769.0
99.98	626.69	604.33	103.21	98.56	1432.8
149.97	636.07	632.41	104.39	103.46	1476.3
199.95	639.86	639.06	104.71	104.50	1488.1

PAGE 12 FILE BS6 01/03/83

	GSNC	XGSNC
PRESENT	.1875	.2500
ORIGINAL	.1000	.3000

PAGE 13 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	576.24	69.47	110.97	9.71	766.4
99.98	610.01	584.57	118.95	113.22	1426.8
149.97	618.64	614.82	120.47	119.91	1473.8
199.95	622.66	621.87	121.21	120.54	1486.3

PAGE 15 FILE BS6 01/03/83

	GSNC	XGSNC
PRESENT	.2500	0.
ORIGINAL	.1000	.3000

PAGE 16 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	559.52	55.25	123.03	22.99	760.8
99.98	593.18	568.10	132.44	127.97	1421.7
149.97	601.45	598.19	134.08	133.29	1467.0
199.95	605.39	602.53	134.72	134.46	1477.1

PAGE 20 FILE BS6 01/03/83

	GSNC	XGSNC
PRESENT	1.000	0.
ORIGINAL	.1000	.3000

PAGE 21 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	312.31	.00	123.03	22.99	458.3
99.98	390.80	192.68	132.44	127.97	843.9
149.97	392.65	389.97	134.08	133.29	1050.0
199.95	393.50	392.35	134.72	134.46	1055.0

PAGE 23 FILE BS6 01/03/83

	GSNC	XGSNC
PRESENT	.7500	62.50A
ORIGINAL	.1000	.3000

PAGE 24 FILE BS6 01/03/83

TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.00	.00	.00	.00	.0
49.99	439.83	.10	121.65	18.71	580.3
99.98	452.34	440.05	129.59	123.55	1145.5
149.97	455.05	452.46	130.67	129.73	1167.9
199.95	456.05	454.99	131.31	131.08	1173.4

PAGE 26 FILE BS6 01/03/83

	GSNC	XGSNC
PRESENT	.5000	.1250
ORIGINAL	.1000	.3000

PAGE 27 FILE BS6 01/03/83

TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.00	.00	.00	.00	.0
49.99	487.33	12.92	117.02	15.22	632.5
99.98	515.60	492.03	126.32	119.31	1253.3
149.97	519.96	516.86	127.80	126.19	1290.8
199.95	522.33	520.14	127.99	127.64	1298.1

PAGE 29 FILE BS6 01/03/83

	GSNC	XGSNC
PRESENT	.2500	.1875
ORIGINAL	.1000	.3000

PAGE 30 FILE BS6 01/03/83

TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.00	.00	.00	.00	.0
49.99	559.52	55.25	113.31	12.37	740.4
99.98	593.18	568.10	122.89	115.76	1399.9
149.97	601.45	598.19	124.28	122.88	1446.8
199.95	605.39	602.53	124.53	124.38	1456.8

PAGE 32   FILE BS6   01/03/83

	GSNC	XGSNC
PRESENT	0.	.2500
ORIGINAL	.1000	.3000

PAGE 33   FILE BS6   01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	632.54	130.18	110.97	9.71	883.4
99.98	665.74	643.25	118.95	113.22	1541.2
149.97	672.47	664.99	120.47	119.91	1577.8
199.95	675.38	670.55	121.21	120.54	1587.7

PAGE 3 FILE BS6 01/03/83

	GSNC	XGSNC
PRESENT	1.000	1.000
ORIGINAL	.1000	.3000

PAGE 4 FILE BS6 01/03/83

TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.00	.00	.000	.000	.00
49.99	312.31	.00	59.697	.000	372.00
99.98	390.80	192.68	77.930	33.768	695.18
149.97	392.65	389.97	78.384	77.704	938.71
199.95	393.50	392.35	78.594	78.305	942.75

PAGE 6 FILE BS6 01/03/83

	GSNC	XGSNC	SPDE1	SPDE2	XSPDE1	XSPDE2
PRESENT	1.000	1.000	1.500	1.500	1.500	1.500
ORIGINAL	.1000	.3000	1.000	1.000	1.000	1.000

PAGE 7 FILE BS6 01/03/83

TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.00	.00	.000	.000	.00
49.99	382.23	.00	75.510	.000	457.74
99.98	396.72	316.85	79.337	61.542	854.45
149.97	396.85	396.70	79.370	79.341	952.25
199.95	396.90	396.84	79.383	79.365	952.48

PAGE 9 FILE BS6 01/03/83

	GSNC	XGSNC	DOLH
PRESENT	1.000	1.000	500.0
ORIGINAL	.1000	.3000	100.0

PAGE 10 FILE BS6 01/03/83

TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.0	.0	.000	.000	.0
49.99	1561.5	.0	59.697	.000	1621.2
99.98	1954.0	963.4	77.930	33.768	3029.1
149.97	1963.3	1949.9	78.384	77.704	4069.2
199.95	1967.5	1961.8	78.594	78.305	4086.2

PAGE 10 FILE BS6 01/03/83

	DOLH
PRESENT	500.0
ORIGINAL	100.0

PAGE 11 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.0	.0	.00	.00	.0
49.99	2947.6	490.5	108.41	7.81	3554.3
99.98	3171.6	3066.2	115.93	110.81	6464.4
149.97	3216.8	3199.0	117.68	116.51	6650.0
199.95	3235.5	3230.4	118.39	117.76	6702.0

PAGE 13 FILE BS6 01/03/83

	DOLL
PRESENT	500.0
ORIGINAL	100.0

PAGE 14 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	589.53	98.09	542.04	39.06	1268.7
99.98	634.31	613.23	579.64	554.03	2381.2
149.97	643.35	639.80	588.38	582.53	2454.1
199.95	647.10	646.07	591.96	588.81	2473.9

PAGE 16 FILE BS6 01/03/83

	GSNC
PRESENT	1.000
ORIGINAL	.1000

PAGE 17 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	312.31	.00	108.41	7.81	428.5
99.98	390.80	192.68	115.93	110.81	810.2
149.97	392.65	389.97	117.68	116.51	1016.8
199.95	393.50	392.35	118.39	117.76	1022.0

PAGE 2 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	589.53	98.09	103.41	7.81	803.8
99.98	634.31	613.23	115.93	110.81	1474.3
149.97	643.35	639.80	117.68	116.51	1517.3
199.95	647.10	646.07	118.39	117.76	1529.3

PAGE 4 FILE BS6 01/03/83

	SPDE1	SPDE2	XSPDE1	XSPDE2
PRESENT	1.500	1.500	1.500	1.500
ORIGINAL	1.000	1.000	1.000	1.000

PAGE 5 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	708.26	197.88	129.36	21.65	1057.1
99.98	819.41	802.93	135.22	130.88	1888.4
149.97	856.68	819.09	140.43	136.78	1953.0
199.95	843.09	845.41	138.45	140.28	1967.2

PAGE 7 FILE BS6 01/03/83

	SPDE2	SPDE1	XSPDE1	XSPDE2
PRESENT	.5000	.5000	.5000	.5000
ORIGINAL	1.000	1.000	1.000	1.000

PAGE 8 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	518.97	.00	96.13	.00	615.1
99.98	533.58	518.42	101.47	78.35	1236.8
149.97	543.49	538.48	102.29	101.30	1285.6
199.95	545.71	543.46	102.66	102.23	1294.1

PAGE 12 FILE BS6 01/03/83

	GSNC	XGSNC	SPDE1	SPDE2	XSPDE2	XSPDE1
PRESENT	1.000	1.000	.5000	.5000	.5000	.5000
ORIGINAL	.1000	.3000	1.000	1.000	1.000	1.000

PAGE 13 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.000	.000	.00
49.99	162.38	.00	32.376	.000	194.76
99.98	421.29	.00	84.129	.000	505.42
149.97	466.13	94.14	93.222	18.668	672.16
199.95	466.29	352.64	93.256	70.299	982.49

PAGE 15 FILE BS6 01/03/83

	GSNC	XGSNC	DOLL
PRESENT	1.000	1.000	500.0
ORIGINAL	.1000	.3000	100.0

PAGE 16 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	312.31	.00	298.49	.00	610.8
99.98	390.80	192.68	389.65	168.84	1142.0
149.97	392.65	389.97	391.92	388.52	1563.1
199.95	393.50	392.35	392.97	391.52	1570.3

PAGE 18 FILE BS6 01/03/83

	GSNC	XGSNC
PRESENT	0.	0.
ORIGINAL	.1000	.3000

PAGE 19 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	632.54	130.18	123.03	22.99	908.7
99.98	665.74	643.25	132.44	127.97	1569.4
149.97	672.47	664.99	134.08	133.29	1604.8
199.95	675.38	670.55	134.72	134.46	1615.1

PAGE 21 FILE BS6 01/03/83

	GSNC	XGSNC	SPDE1	SPDE2	XSPDE1	XSPDE2
PRESENT	0.	0.	1.500	1.500	1.500	1.500
ORIGINAL	.1000	.3000	1.000	1.000	1.000	1.000

PAGE 22 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	814.14	243.92	179.49	41.62	1279.2
99.98	894.84	856.71	180.98	172.43	2105.0
149.97	937.55	938.22	189.04	188.52	2253.3
199.95	953.94	920.91	192.12	188.26	2255.2

PAGE 24 FILE BS6 01/03/83

	GSNC	XGSNC	SPDE1	SPDE2	XSPDE1	XSPDE2
PRESENT	0.	0.	.5000	.5000	.5000	.5000
ORIGINAL	.1000	.3000	1.000	1.000	1.000	1.000

PAGE 25 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.00	.00	.00	.00	.0
49.99	532.93	4.08	106.47	.75	644.2
99.98	554.38	534.33	110.80	106.73	1306.2
149.97	559.82	554.63	111.92	110.85	1337.2
199.95	562.28	559.92	112.42	111.93	1346.5

PAGE 27 FILE BS6 01/03/83

	GSNC	XGSNC	DOLH
PRESENT	0.	0.	500.0
ORIGINAL	.1000	.3000	100.0

PAGE 28 FILE BS6 01/03/83

TIME	VAL11	VAL12	VALX1	VALX2	VALTT
E+00	E+00	E+00	E+00	E+00	E+00
.0	.0	.0	.00	.00	.0
49.99	3162.7	650.9	123.03	22.99	3959.6
99.98	3328.7	3216.3	132.44	127.97	6805.4
149.97	3362.3	3324.9	134.08	133.29	6954.6
199.95	3376.9	3352.8	134.72	134.46	6998.8

PAGE 30 FILE BS6 01/03/83

	GSNC	XGSNC	DOLL
PRESENT	0.	0.	500.0
ORIGINAL	.1000	.3000	100.0

PAGE 31 FILE BS6 01/03/83

TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.00	.00	.00	.00	.0
49.99	632.54	130.18	615.16	114.93	1492.8
99.98	665.74	643.25	662.20	639.84	2611.0
149.97	672.47	664.99	670.39	666.44	2674.3
199.95	675.38	670.55	673.62	672.31	2691.9

PAGE 33 FILE BS6 01/03/83

	GSNC	XGSNC
PRESENT	.5000	.5000
ORIGINAL	.1000	.3000

PAGE 34 FILE BS6 01/03/83

TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.00	.00	.00	.00	.0
49.99	487.33	12.92	97.19	2.22	599.7
99.98	515.60	492.03	103.21	98.56	1209.4
149.97	519.96	516.86	104.39	103.46	1244.7
199.95	522.33	520.14	104.71	104.50	1251.7

PAGE 36 FILE BS6 01/03/83

	GSNC	XGSNC	SPDE1	SPDE2	XSPDE1	XSPDE2
PRESENT	.5000	.5000	1.500	1.500	1.500	1.500
ORIGINAL	.1000	.3000	1.000	1.000	1.000	1.000

PAGE 37 FILE BS6 01/03/83

TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.00	.00	.00	.00	.0
49.99	562.17	68.07	113.71	11.69	755.6
99.98	606.66	587.24	120.81	115.38	1430.1
149.97	610.34	604.92	122.77	121.47	1459.5
199.95	614.45	612.80	122.87	122.56	1472.7

PAGE 41 FILE BS6 01/03/83

	GSNC	XGSNC	SPDE1	SPDE2	XSPDE1	XSPDE2
PRESENT	.5000	.5000	.5000	.5000	.5000	.5000
ORIGINAL	.1000	.3000	1.000	1.000	1.000	1.000

PAGE 42 FILE BS6 01/03/83

TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.00	.00	.000	.000	.0
49.99	386.55	.00	77.057	.000	463.6
99.98	492.51	227.00	98.487	45.011	863.0
149.97	493.54	491.99	98.699	98.380	1182.6
199.95	494.00	493.36	98.794	98.662	1184.8

PAGE 44 FILE BS6 01/03/83

	GSNC	XGSNC	DOLH
PRESENT	.5000	.5000	500.0
ORIGINAL	.1000	.3000	100.0

PAGE 45 FILE BS6 01/03/83

TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.0	.0	.00	.00	.0
49.99	2436.6	64.6	97.19	2.22	2600.6
99.98	2578.0	2460.2	103.21	98.56	5240.0
149.97	2599.8	2584.3	104.39	103.46	5391.9
199.95	2611.6	2600.7	104.71	104.50	5421.5

PAGE 47 FILE BS6 01/03/83

	GSNC	XGSNC	DOLL
PRESENT	.5000	.5000	500.0
ORIGINAL	.1000	.3000	100.0

PAGE 48 FILE BS6 01/03/83

TIME E+00	VAL11 E+00	VAL12 E+00	VALX1 E+00	VALX2 E+00	VALTT E+00
.0	.00	.00	.00	.00	.0
49.99	487.33	12.92	485.93	11.11	997.3
99.98	515.60	492.03	516.06	492.81	2016.5
149.97	519.96	516.86	521.93	517.28	2076.0
199.95	522.33	520.14	523.53	522.50	2088.5

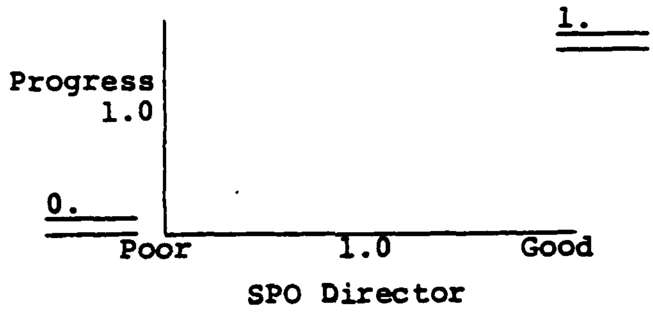
APPENDIX C

INITIAL SURVEY--SPO OPERATION PERCEPTIONS

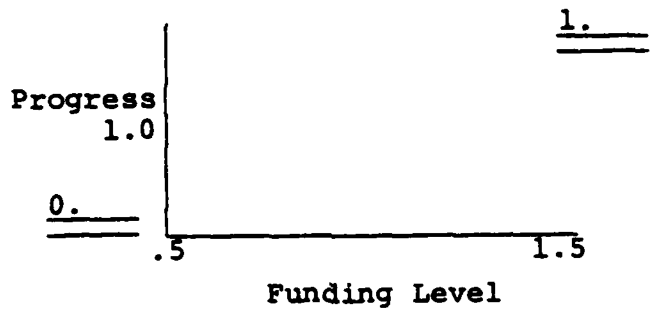
Relationships

Respondents should fill in the two blanks (_____) for each figure.

<u>SPO Director Effectiveness</u>: The contribution of the SPO Director to progress.



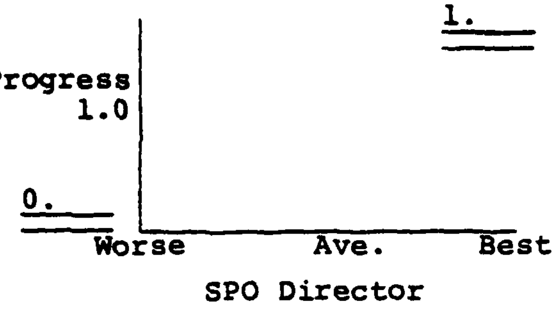
<u>Funds</u>: The affect of funding changes on progress.



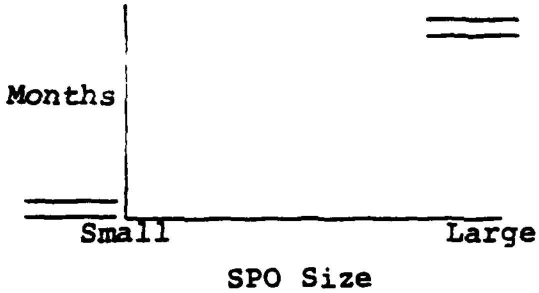
Planned Funds = 1.0

<u>Note</u>: The respondents were briefed on this survey and all questions were cleared.

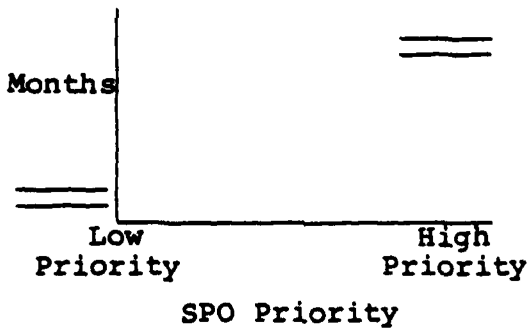
Desire to Change Progress Rate: This is the SPO Director's influence on changing progress when he desires to do so.



Perceived Actual Progress: Since it is often difficult to actually know the progress on a major system, we rely on perceptions. Typically we overperceive. In months show what you would consider the typical delay between actual progress and reported progress.

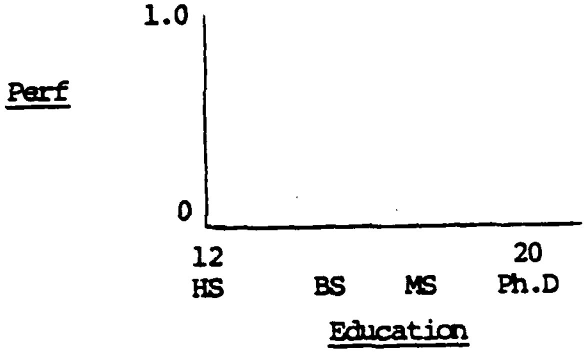


Funds Available: From SPO Director request until receipt of funds (additional) show the time required in months.

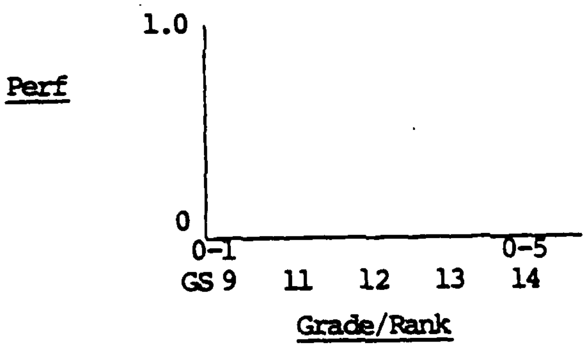


Performance

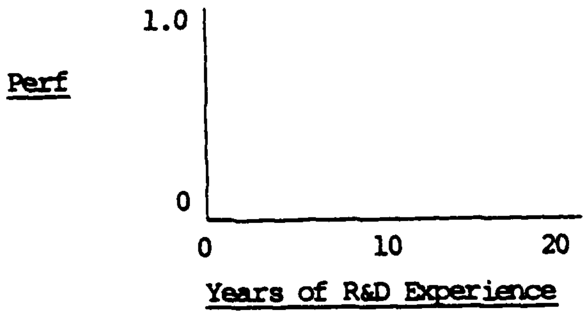
Think typical people consider all vs. the most talented in ASD.



Note: Mark on the graph above each educational level your perception of a person's contribution compared to the most talented in ASD which equals 1.0.



Note: Do the same as above but consider grade or rank.



Note: Do the same as above but consider years of R&D experience.

APPENDIX D

SECOND SURVEY--AN ASD MOE SURVEY

SUBJECT: A MOE FOR ASD

TO: EXPERIENCED ASD SPO PERSONNEL

UNDER THE SPONSORSHIP OF ASD/AV (MR. JIM COOLEY, 5526U, CONTACT PERSON) AND THE ADMINISTRATIVE SUPPORT OF THE AIR FORCE BUSINESS RESEARCH MANAGEMENT CENTER (CAPT MIKE TANKERSLEY, 56221, CONTACT PERSON) PJSA IS COMMITTED TO DETERMINING A MEASURE OF EFFECTIVENESS FOR ASD. WE NEED YOUR HELP.

PLEASE COMPLETE THE ATTACHED FORM AND RETURN IT IN THE STAMPED SELF ADDRESSED ENVELOPE. YOUR RESPONSES TO THE PAIRED COMPARISONS SHOULD ADDRESS EACH ITEM AGAINST EVERY OTHER ITEM AND WILL LOOK SOMETHING LIKE THE FOLLOWING WHEN FINISHED.

✓	✓			✓
	✓		✓	
✓		✓		✓
	✓	✓		
			✓	✓

THANK YOU.

I. As part of a research project, a rating function for evaluating the success of a SPO is being developed. This function is to be based on three factors; actual cost vs target cost, actual schedule vs target schedule, and actual performance vs target performance.

A series of matrices have been developed to aid in assessing the relative merits of the three factors (cost, schedule, and performance) in evaluating the success of a particular SPO. Each matrix has been constructed for comparing two of the factors. In making the assessments for the various combinations shown, we are stating that the row factor is more important than the column factor.

Please indicate your agreement or disagreement by checking the block if you agree that the row factor is more important and leaving it blank if you do not agree. For example: If you agree that the SPO would receive a higher rating for being 40% under cost than if it were 20% ahead of schedule, then the block in the first row and first column of the first matrix below would be checked (✓).

✓ = ROW MORE IMPORTANT THAN COLUMN

Column

Cost \ Sched	20% early	10% early	ON TARGET	10% late	20% late
40% under					
20% under					
ON TARGET					
20% over					
40% over					

COST vs SCHEDULE

Column

Row

Cost \ Perf	20% below	10% below	ON TARGET	10% above	20% above
40% under					
20% under					
ON TARGET					
20% over					
40% over					

COST vs PERFORMANCE

Column

	Sched \ Perf	20% below	10% below	ON TARGET	10% above	20% above
	20% early					
	10% early					
Row	ON TARGET					
	10% late					
	20% late					

SCHEDULE vs PERFORMANCE

1. In developing an overall performance measure for ASD, which would you consider to be more important:

   a. Dollar value of the project?
   b. Priority of the project?

2. If you chose b above, indicate where the priority of most concern is established.

   a. ASD (internal)
   b. AFSC
   c. Air Force

FIL

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